A WINDOW OPEN ON THE WORLD

The UNESCO Courier

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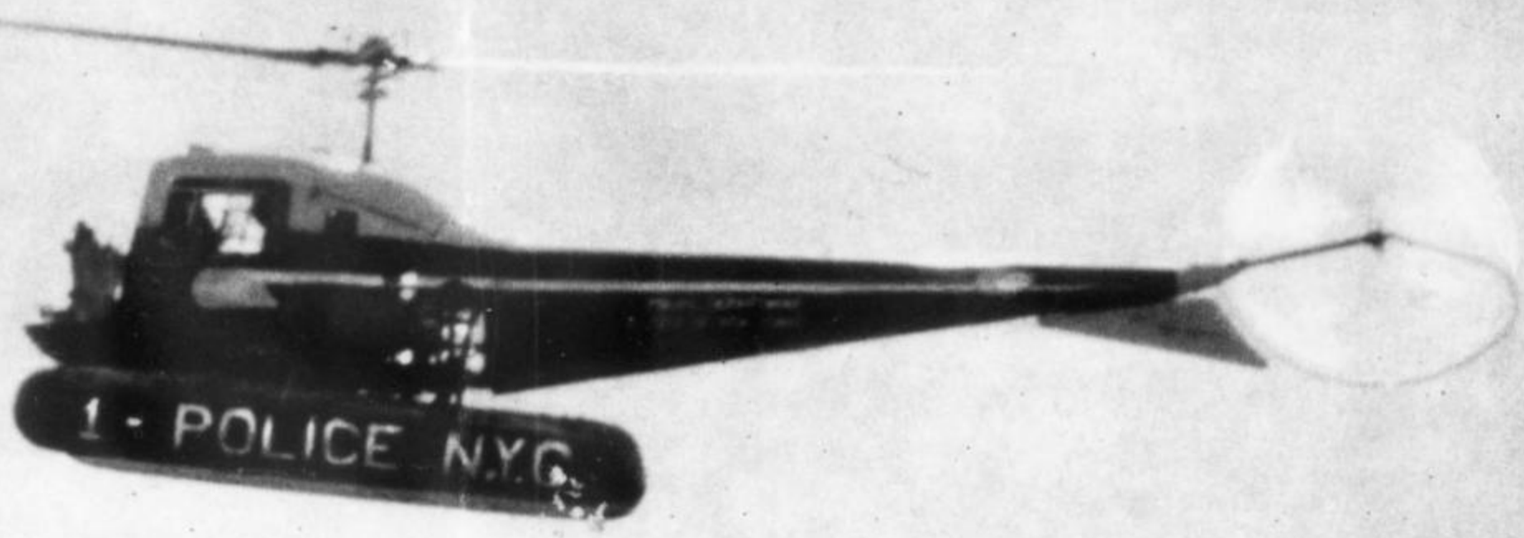

THE WORLD'S HIGHWAYS

JUNE
1959
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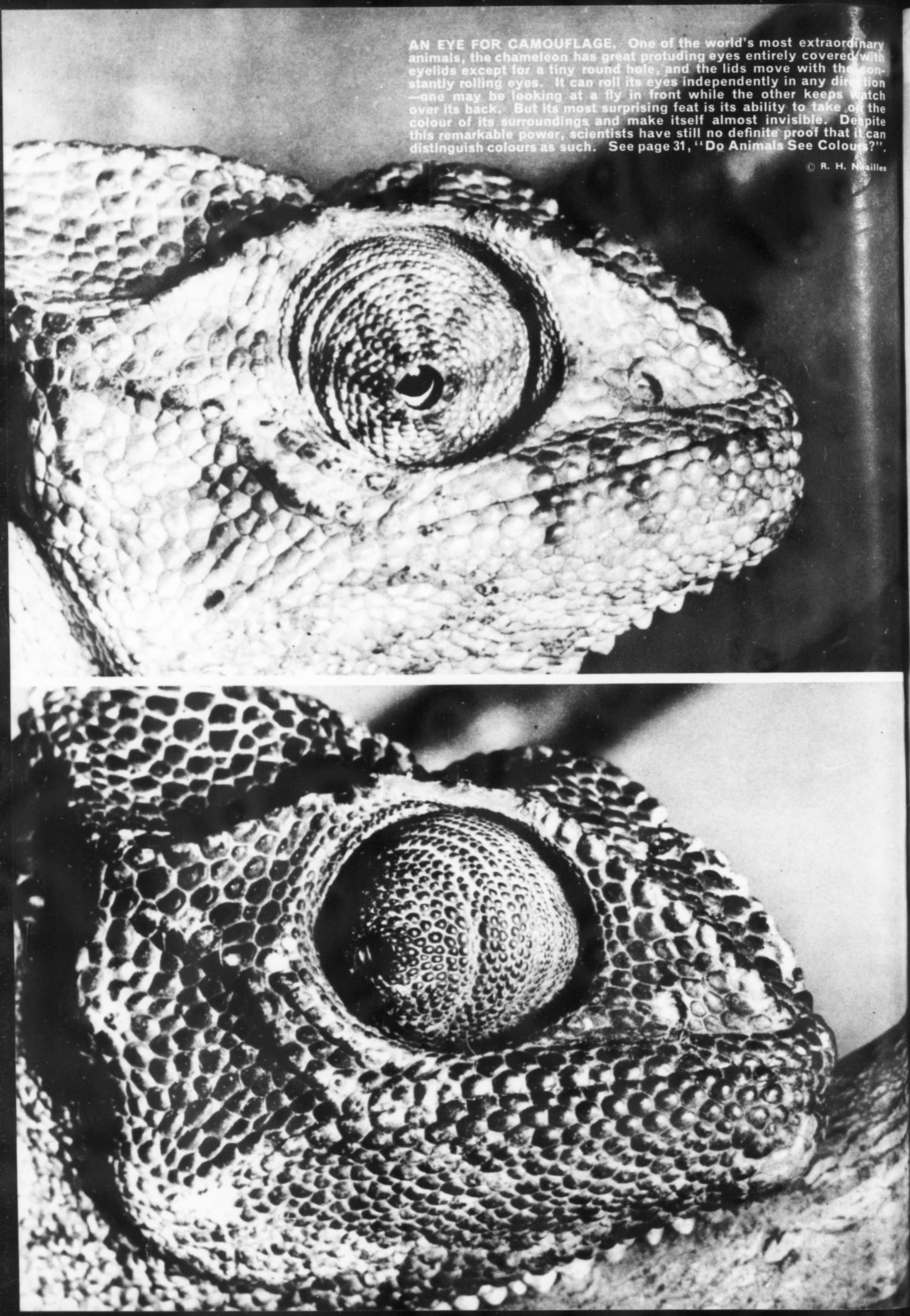

AN EYE FOR CAMOUFLAGE. One of the world's most extraordinary animals, the chameleon has great protuding eyes entirely covered with eyelids except for a tiny round hole, and the lids move with the constantly rolling eyes. It can roll its eyes independently in any direction —one may be looking at a fly in front while the other keeps watch over its back. But its most surprising feat is its ability to take on the colour of its surroundings and make itself almost invisible. Despite this remarkable power, scientists have still no definite proof that it can distinguish colours as such. See page 31, "Do Animals See Colours?".

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12TH YEAR

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N° 6

TOWARDS A WORLD HIGHWAY

© Almasy, Paris

by

W. H. Owens

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Dangerous curves.

Good roads are much more than efficient traffic pavements. They link the nations and their different ways of life, stimulate trade and travel, and so help to advance the cause of international understanding. The modern highway engineer, as he conquers Nature's barriers and brings peoples closer together, is making a really important and lasting contribution towards world peace and prosperity.

Highway construction on a fast growing scale is in progress in every continent today. Road teams are taming the wilderness, stretching the frontiers of civilization, and bringing remote and hitherto untapped areas of the Earth's natural riches under development. As motor transport replaces pack and draught animals in backward territories, the primitive trackways and dirt roads of tradition are being changed into all-weather surfaced highways.

Great international projects like the Pan-American Highway, the Trans-African Highway and the London-Baghdad Highway are bringing the dream of a global motor route nearer to fulfilment. The time is surely approaching when motorists will be able to drive round the world on these trans-continental roads, stretching from sea to sea and linked up across the oceans by a network of air ferries.

Threading its way among peoples, scenery and climate as diverse as any on Earth is the 15,000-mile Pan-American Highway—the world's longest road system. This is not a single ribbon of road, but a super-international network that includes the principal highways of all the countries and states from Alaska south to the Argentine. There is no specified route through the United States, for example, because any one of a number of interlocking State and national highways can be used to reach the Pan-American system in Mexico or Alaska.

Over a century has passed since the U.S. statesman Henry Clay first proposed a hemispheric road to unite the Americas. Far ahead of his time he realised the tremendous influence that such a highway could have on the economic and cultural relations of the Western Hemisphere. Its importance is infinitely greater today with the increasing development in Latin-American countries.

By far the greater part of the Fairbanks-Buenos Aires route has been open for years. Now road crews, backed by further U.S. loans, are working with heavy mobile equipment to pave the last, but most difficult, stretches through the Central American Republics. These gaps together total only 500 or 600 miles. But climate and terrain in Guatemala, Costa Rica, Panama and neighbour states have created vast problems and hazards, slowing down the work. Sometimes the laborious work of years has been destroyed by torrential rains in as many days. This happened in 1955 on the Cartago-San Isidro stretch in Costa Rica, where 500,000 cubic yards of volcanic soil was washed right out of the newly laid road foundations.

No other continuous land route in the world can surpass America's hemispheric road for spectacular and contrasting scenes. The Highway crosses the desolate frozen wilderness, sun-baked deserts and the horizon-wide pampas; plunges through deep canyons and steaming tropical jungles; winds up and down the escarpments of mighty mountain ranges, 14,000 to 15,000 feet above sea level. It enters the polar regions in Alaska and crosses the equator in Ecuador. In Mexico and further south, the Pan-American route runs hundreds of miles over desert country where local Indian communities follow the same primitive pattern of life as the white man found when first he set foot in the Americas.

Some of the most important highway developments outside America today are in progress in Africa, where, despite rapidly changing conditions in the economic field, communications are still among the most primitive in the world. Thousands upon thousands of miles of bush and jungle trackways form an intricate web over the interior of Africa, linking village with village and pointing out the safer paths.

But the motor vehicle has made its impact on that great continent as everywhere else, and modern road transport—the key to future development—cannot function efficiently on routes that are extremely hazardous, and often impassable, in the rainy season. This and the need for direct links between new areas of production and markets have made the construction of long-distance surfaced roads an urgent matter. Prospects for African inter-territorial trade are quite unlimited provided a modern system of roads is built to carry it.

African transport conferences since World War II have discussed the problem of long-distance motor highways. The first steps towards an integrated network were taken at the African Transport Conference at Johannesburg in 1950, where a number of primary routes linking the various territories were worked out in some detail. Delegates agreed that the inter-territorial routes should permit safe travel at an average speed of 40 miles per hour. Present road building operations inside Africa are widely scattered, unrelated and planned primarily to serve new

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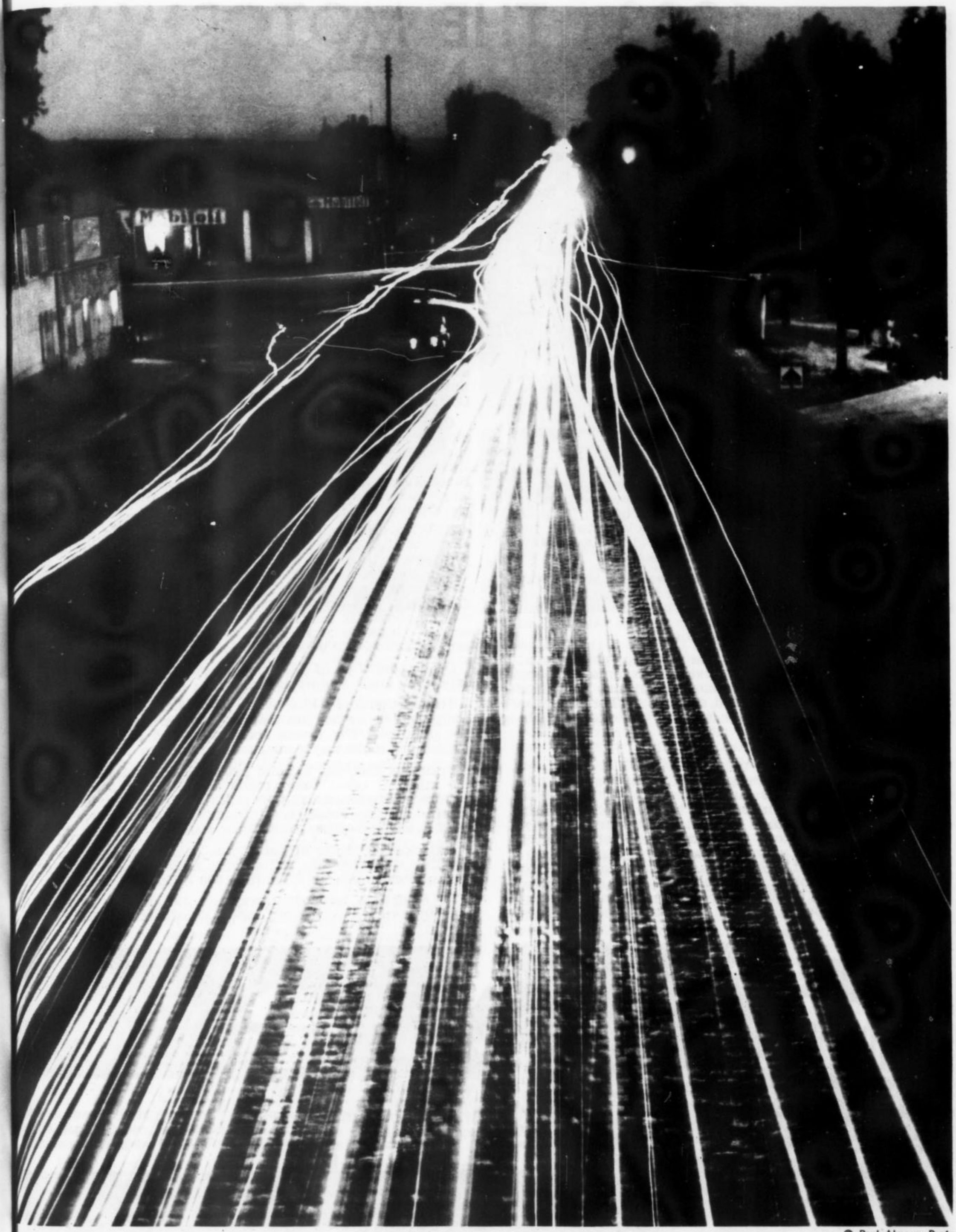

© Paul Almasy, Paris

NIGHTRIDE. Streaming south from Paris down the main highway to the Mediterranean coast, night-riding automobiles leave a dazzling pathway of light as the beams of their headlamps are captured by a long photographic exposure. With 650,000 km. of main and secondary roads and 119 km. per 100 sq.km. of surfaced roads, France has the highest density of roads in the world. Since recent reconstruction work has been carried out, network is valued at £7,000 million—one-tenth of the country's total assets.

WORLD HIGHWAY *(Continued)*

1923: THE MOTORWAY IS BORN IN ITALY

mining, forestry, agricultural or irrigation projects. Eventually, however, they will gradually become merged together as part of a through continental highway system.

At the northern end of the future Trans-African route, great highway improvements were made by Allied troops in World War II. They completed the long Mediterranean coast road from Tangier to Alexandria, while inland heavy transport roads were laid over some of the traditional camel tracks. So today there are two or three long-distance highways pushing southward across the Sahara and the Sudan into the heart of Africa.

In May, 1957, the African Regional Road Congress met at Salisbury, Southern Rhodesia, and was attended by delegates and observers from East, Central and South Africa, the Belgian Congo, Portuguese Africa and the United Kingdom. Discussions centred on the £10-£15 million scheme to modernize the Cape-Nairobi Highway—the backbone of future long-distance transport in Africa—over its entire length, and to develop the necessary link and feeder roads into adjacent Belgian and Portuguese territories.

The tremendous value of this trunk route for stimulating the flow of inter-territorial trade was emphasized by Congress speakers. A South African delegate estimated that if the Cape-Nairobi Highway was brought up to international heavy duty standards, trade between the Union and East and Central Africa could alone increase to some £250 million within the next decade.

A particularly difficult section of the Nairobi highway was recently completed in the wilds of Northern Rhodesia, between Chirundu and Lusaka. These 94 miles run through steep mountains and densely wooded valleys, then drop 3,000 feet into the Zambezi lowlands.

Maintenance camps had to be set up at frequent intervals along the route to service heavy road-making machinery working under abnormal strain, and four wayside stone quarries supplied materials. The immense problems created by the rough terrain, uncertain climate and utter remoteness of the site were overcome only by the most detailed organization combined with excellent teamwork between Europeans and Africans.

Africans themselves are playing a big part in the construction of highways and bridges, and work with great keenness and enthusiasm side by side with European engineers and technicians. At Tala, in the hills east of Nairobi, the Kenya Road Authority has established a training school where young Africans from many different tribes learn all about modern road construction and how to handle heavy mobile machinery. After a six months' course they emerge as qualified road supervisors and plant operators. Equipped with their newly-acquired skill they return to their own districts to take a responsible part in turning bush tracks and game trails into all-weather roads that will make Kenya's new farmlands more accessible to the markets and railheads.

In Europe the most significant road development has been the super highway, or motorway, designed and built especially for the needs of motor traffic. (Such highways are most common in the United States, of course, where thousands of miles of them have been constructed over the past thirty years.)

The first motorways in Europe were built by the Italian Government as early as 1923, but these autostrade made no provision for dividing the opposite traffic streams. It was in Germany and Holland that motorways with separate carriageways, grade separation and full control of access were developed; the first of the famous German autobahnen built on such lines, between Bonn and Cologne, was completed in 1932.

Germany's autobahnen have been described as the most beautiful motor roads in the world. No effort was spared to make them so without affecting their high standard of safety and efficiency. In scenic areas like the Black Forest and the Bavarian Alps, landscape architects were employed to adapt the alignment of the new motorways in harmony with the changing scenery.

Ever since the war Western Germany has been pressing ahead with the task of completing the national autobahn programme that was interrupted in 1939. She plans to double her pre-war 1,200-mile autobahnen network in the next ten to fifteen years. In 1956 the West Germans spent £29 million on new autobahnen alone. In 1957 the figure rose to about £52 million, and in a few years expenditure on new highways of all kinds, including improvements to existing roads, will be averaging about £125 million a year.

Other countries of Western Europe are also gradually extending their motorway mileage.

The Netherlands has over 400 miles of motorways completed or under construction, and another 600 miles are planned. The Dutch spent nine and a half million pounds on motorway construction alone in 1956.

France is planning to build 1,000 miles of motorways and 150 miles of other main roads at a cost of some £300 million. Between 40 and 50 miles of French motorways, chiefly on the outskirts of Paris, are already open to traffic, and a further 86 miles are under construction

Italy has 306 miles of autostrada completed and is now building a further 530 miles while Belgium has 72 miles of motorway open, and another 600 miles are planned.

In Austria a new motorway of 196 miles, between Salzburg and Vienna, is under construction. Built to

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POLYGLOT PANEL. In the countries which adhere to the international agreement on road traffic signs sponsored by the United Nations, most of the signs lining the highways bear standardized symbols. On this Danish road, the international sign indicating that one half is closed to traffic is supplemented by a signal panel in five languages which also shuts off the area being repaired.

© Dudley Noble

AFRICA HAS CHANGED since the days when David Livingstone was obliged to hack out a road through bush country and jungle as he travelled from the Cape almost to the Equator. Road construction is being pushed ahead. Africa needs highways now to develop both internal and international trade. Plans for new highways include one which will run from Cape Town to Nairobi, with links to Belgian and Portuguese territories. In the north east, work on road construction and maintenance in Ethiopia has developed rapidly since the International Bank for Reconstruction and Development made a $5 million loan in 1950. Photos show: left, viaduct in Ethiopia's mountainous terrain ; right, a section of one of the 4,500 kms of all-weather roads in Ethiopia and Eritrea.

autobahn specifications, this first Austrian motorway will link up with the West German system.

Thus it is seen that the countries of Western Europe, too, are integrating their national road systems towards an eventual network of Continental motor highways, built to standard specifications throughout. Europe's longest international route, E.5, runs from the seaport of Ostend right through to Athens and Istanbul, and thence on to Baghdad.

While the western end of this route runs over some of the world's most up-to-date motor roads—the new Ostend-Brussels Motorway and the famous autobahns of Germany—the Balkans end still has long stretches that are far below European highway standards. But a great deal of road construction and modernization is now in progress in Yugoslavia, Greece and Turkey.

The major road-building achievement in Yugoslovia since 1945 is the 240-mile motor highway between Zagreb and Belgrade. This is the fastest traffic highway in that country and, apart from its level crossings, might compare favourably with the new motorway construction in Western Europe. A key link is the splendid new Save River Bridge at Belgrade, connecting the capital and Southern Serbia with the highway to Zagreb and Western Europe. More than half the cost of this £3 million bridge was covered by United States development funds.

In Greece, more than half the road system was destroyed or made temporarily impassable during World War II. But in the past ten or twelve years remarkable progress has been made with its repair and reconstruction. This small country has spent nearly £15 million on its roads since the war, and with the aid of American technicians more than a thousand bridges have been restored to use.

Turkey, too, has made considerable headway with the modernisation of her road system, and has more than doubled the mileage of all-weather surfaced highways since 1948. Such highways now total about 11,000 miles, and another 700 miles are under construction. Much work has been done on the busy Istanbul-Ankara section of the international route, E.5, and this has been reconstructed as a motorway.

In Turkey the highways of the West meet those legendary trade routes of bygone centuries, which stretch far eastwards across Persia into the heart of Asia. These are among the world's most romantic roads, for they include the early silk routes between China and Western Asia, age-old caravan trails leading through Afghanistan and the Khyber Pass into Northern India, and roads that cross desolate and uninhabited regions on the borderland of Northern Persia and Russia Turkistan, east of the Caspian Sea.

Someday the European motor road to Istanbul and Baghdad may be carried on through Persia and Afghanistan to make a continuous overland route from Western Europe to Pakistan and India. This motorist's dream may perhaps become a reality sooner than expected. For recent discussions between Turkey and Pakistan included the subject of a long-distance highway to link the capital cities of Istanbul, Baghdad, Teheran and Karachi. This would be part of the projected Pan-Asian Highway to India and Malaya. (See p. 11)

Road-building achievements of the future in all the continents are quite unlimited. As they gradually materialize, greater opportunities for international trade and co-operation in other fields—as well as undreamed of travel delights—will be opened up. But if mankind is to gain the wonderful freedom that travel on the world highway can offer, the nations must agree, sooner or later, to get rid of the artificial barriers and tiresome frontier delays and restrictions at each national boundary. So long as we cling to them the purpose of a global highway can never be fully achieved.

PAY AS YOU GO. Turnpike gates (upper part of photo) on the highway from New Jersey (centre). Through traffic to and from New Jersey uses centre lanes. Side lanes (left and right) lead to and from the Lincoln Tunnel which takes traffic into New York City under the Hudson River.

PATTERN OF SUPER HIGHWAYS IN THE U.S.A.

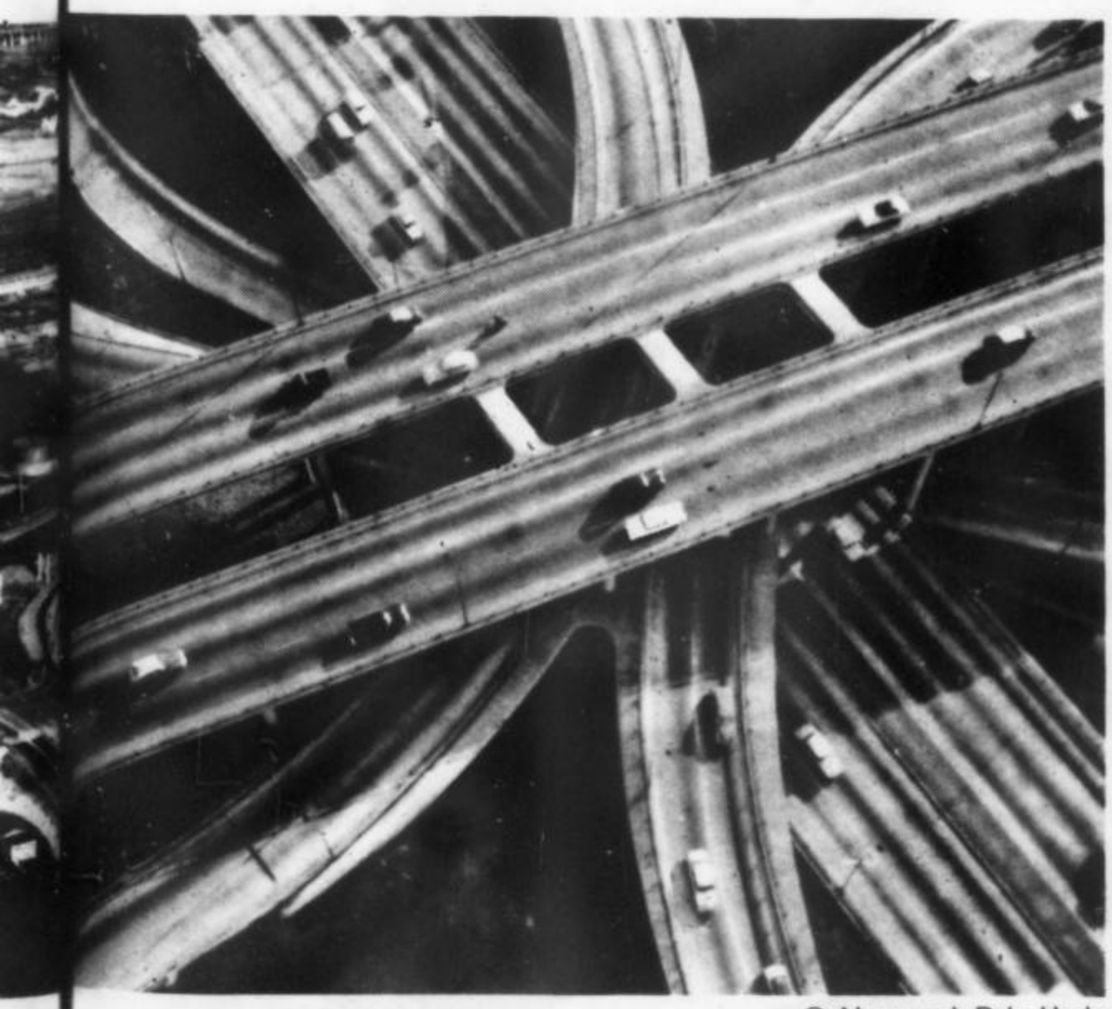
One out of every seven Americans earns his living in some phase of highway travel; 80% drive to work; 85% take their vacations and pleasure trips by automobile. With an ever-expanding economy and an ever-growing fleet of automobiles, trucks and buses (now well over 65 million), the United States has embarked on a vast construction programme to provide enough roads to accomodate the nearly 90 million vehicles which are expected to be circulating by 1972. This 16-year building programme will crisscross the U.S.A. with an inter-state super-highway network covering well over 40,000 miles, plus thousands of miles of state and local roads. Reaching out into every corner of the country, the new web of highways will link 42 state capitals and 90% of all cities with more than 50,000 population. It will cost $100,000 million—nearly 300 times the cost of the Panama Canal—but with fewer curves, no crossroads, and a wide centre strip, the super system is expected to save 3,500 lives annually, reduce accident costs by $725 million and save transport companies a further $825 million by cutting delay, fuel waste, tyre and brake wear. Construction on this scale is only possible because of the power, speed and versatility of today's road building machines: moving assembly lines or "paving trains" can place up to 3/4 of a mile of 12 foot concrete lane, eight inches thick, in one eight hour day; batching plants serve up just the right mixture of rock, sand and asphalt at the touch of a button. Photos on these pages show some of the arabesque patterns, whorls, intricate "knots" and geometric cloverleafs which are found at the junctions of some of American's existing superhighways.

TRAFFIC PROBLEM in California—from three million motor vehic in 1940 to six million in 1955—is being met by massive roadbuildi programme: 1,000 miles of multi-lane highways built in past ten yea Above, section of Arroyo Seco road linking Pasadena and Los Angele

NEW JERSEY TURNPIKE coming from bottom right of photo cross Passaic River (centre) and Hackensack River (top right). In foregrou the Pulaski 'Skyway' is seen 'leapfrogging' the New Jersey Turnpik The 'Skyway' is one of the major modern roads leading into New Yor

PENNSYLVANIA TURNPIKE, completed in 1954, was one of U.S.A.'s first superhighways. It runs 360 miles from the Delaware River in the east to the Ohio border on the west, connecting Philadelphia and Pittsburgh. This highway has no crossroads, sharp curves or steep grades.

PAY AS YOU GO. Turnpike gates (upper part of photo) on the highway from New Jersey (centre). Through traffic to and from New Jersey uses centre lanes. Side lanes (left and right) lead to and from the Lincoln Tunnel which takes traffic into New York City under the Hudson River.



© Newsweek-Dale Healy

FOUR LAYERS of overpass bridges in Los Angeles, California, which has more automobiles per number of inhabitants than any other city in the world. The city has already built over 100 miles of urban "freeways" and is planning vaster network of highways to relieve traffic congestion.

LINKED MOTORWAYS. Near to Detroit, Michigan, these two motorways—one with double lanes, the other following the shore of Lake Michigan—are linked by ramps and underpasses. An arrangement of this type keeps traffic moving at speed and cuts out dangerous intersections.

THE BURMA ROAD which became a vital communications link for the Allies in the Second World War, is an old caravan route reconstructed by modern road-building methods to meet the needs of motorized transport. The modernization of Asia's famous caravan routes of old is the basis of the vast plan to create an Asian highway network running from Vietnam to Turkey.

USIS

ASIAN HIGHWAY routes shown on this map are often ancient caravan trails, now destined to become an up-to-date highway system. Circles indicate where road is unsuitable for motor traffic during the rainy season or where link roads are still inexistent.

CARAVAN ROUTES TO LIVE AGAIN

MOTORISTS will soon be able to drive all the way across the continent of Asia—from Turkey to the shores of Indo-China or Malaya—on the famous caravan routes of antiquity which are to be modernized and linked up in a new Pan-Asian Highway.

Stretching for some 7,000 miles, the Pan-Asian Highway is part of a bold and imaginative project conceived by the Highway Subcommittee of the U.N. Economic Commission for Asia and the Far East (ECAFE) to endow southern Asia with an up-to-date international highway system. The backbone of the undertaking will be the great network of old caravan routes which have survived the ravages of time although some date back to as much as 1,000 years before the Christian Era. It is over these caravan routes that Marco Polo and other travellers like Fa-Hsien and Ibn Batuta explored the lands of the East, that the armies of Gengis Khan, Alexander the Great and Tamerlane marched on their road to conquest, and that the silk, jade and spices of the Orient were transported by the traders of the past.

Twelve hundred years before Christ extensive trade routes were already in existence under the reign of Salmanasar I, King of Assyria, and the nobles of his court wore precious ornaments made with lapis lazuli and other jewels which came from Afghanistan. The famous Silk Road ran from Chungking through Burma and North India on to Delhi, and from there to Teheran and Samarkand, then west across the Caspian Sea and through Tiflis to the Black Sea.

It is hard for us today to realize the hardships and hazards endured during journeys in those far off times: the vast distances that had to be covered on foot or horse or camel back often took months, even years; progress was impeded by the huge stretches of dusty plains and parched deserts to be crossed, the turbulent rivers to be forded and the high mountain ranges to be scaled. Then too, there was always the

CONTINUED ON NEXT PAGE

CARAVAN ROUTES
(Continued)

NEW PAN-ASIAN HIGHWAY WILL LINK LANDS FROM MALAYA TO IRAN

lurking danger of cut-throat bandits who would hurl themselves down on the slow-moving caravans, murdering the travellers and making off with the rich cargo.

The caravans carried an extremely wide range of goods: tin from England, copper ore from Spain, timber from northern Europe, iron from central Africa, Iran and India, spices from the Moluccas, silks from Sian Fu (China) and cottons from Egypt and Mekran (now in Pakistan).

The development of trade routes was by no means easy. Asia is made up of vast plains, some fertile others totally desert, mountain ranges which include some of the highest in the world, and rivers, mighty and long and often turbulent. The trade routes naturally sought out the mountain passes (most of them still in use) and followed the rivers. Where possible, caravan routes were preferred to the hazards at sea.

The establishment of great kingdoms greatly helped in stabilizing and providing some security to trade routes and developing them, though the extent to which security could be provided was limited by the rulers' ability and power. The establishment of the Han dynasty in China, the rise of Cyrus and of Alexander the Great, and the large-scale missionary efforts of Asoka—all helped towards stabilizing the caravan routes and trade patterns in Asia.

The Romans, in the period 266 B.C.-476 A.D., built roads which extended over three continents. These were built primarily for military purposes but good communications with security of travel gave a considerable impetus to the development of trade and commerce. Exchange of commodities was carried on through Greece and Syria, and merchants travelled as far as Merv or Samarkand in Turkestan, Kandahar in Afghanistan and through the Khyber Pass over the road across north India to the Ganges plain. In the Byzantine Empire, trade with the East by caravan flourished. Baghdad gave the Moslem world good roadways with inns (serais) and provision for relays of mounts for traders, pilgrims and official courtiers. These roads were linked with those of central Asia and even of China and constituted the great trade routes between the East and the West, and the important international land links between the cultures and civilizations of the Orient and the Occident.

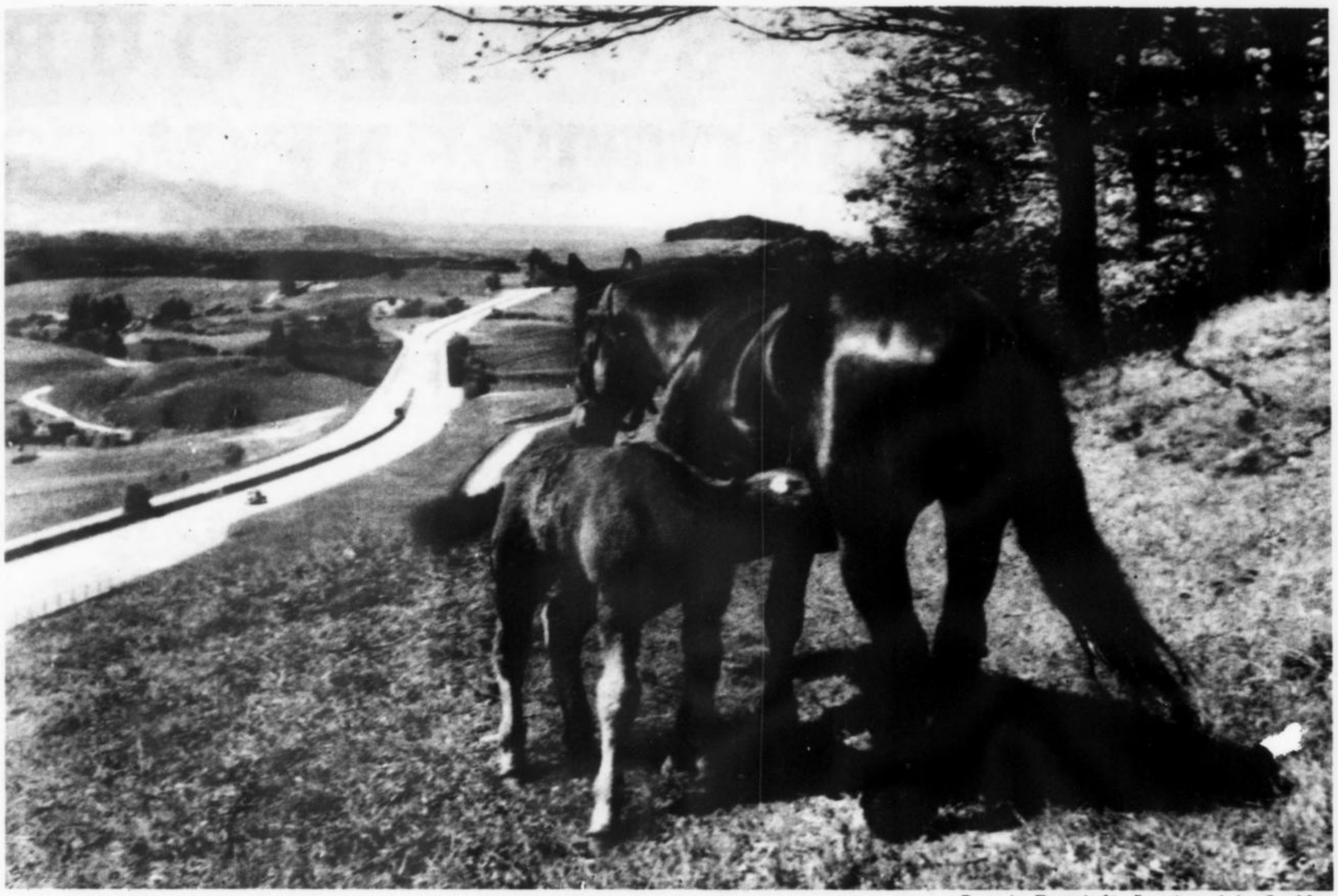
Today, however, many of these land routes have fallen into disuse and cannot possibly meet the needs of the developing countries of south Asia. The creation of a vast network of international highways, linking up the existing roads and raising these to the standards needed for motorized traffic has thus become an urgent, priority problem.

The highway project was born following a careful study of this situation in 1955, when the Highway Subcommittee of ECAFE undertook a study of the possibilities of a highway development plan to link all the countries between Vietnam and Iran. This plan was approved by ECAFE early this year. The region has been divided into three zones. The first will cover the road network of Vietnam, Cambodia, Laos, Thailand, Malaya and Burma. The second will englobe Burma's western connexions, East Pakistan, India, Ceylon, Nepal and motor roads to West Pakistan. The third will comprise West Pakistan, Afghanistan and Iran.

ECAFE's highway experts agree that the first priority task is to build the highway links needed to connect the existing road systems. Already work has been started by some countries.

As goods which will travel on the Asian highway will often have to pass through several countries before reaching their final destination, it is proposed to simplify customs formalities and border procedures.

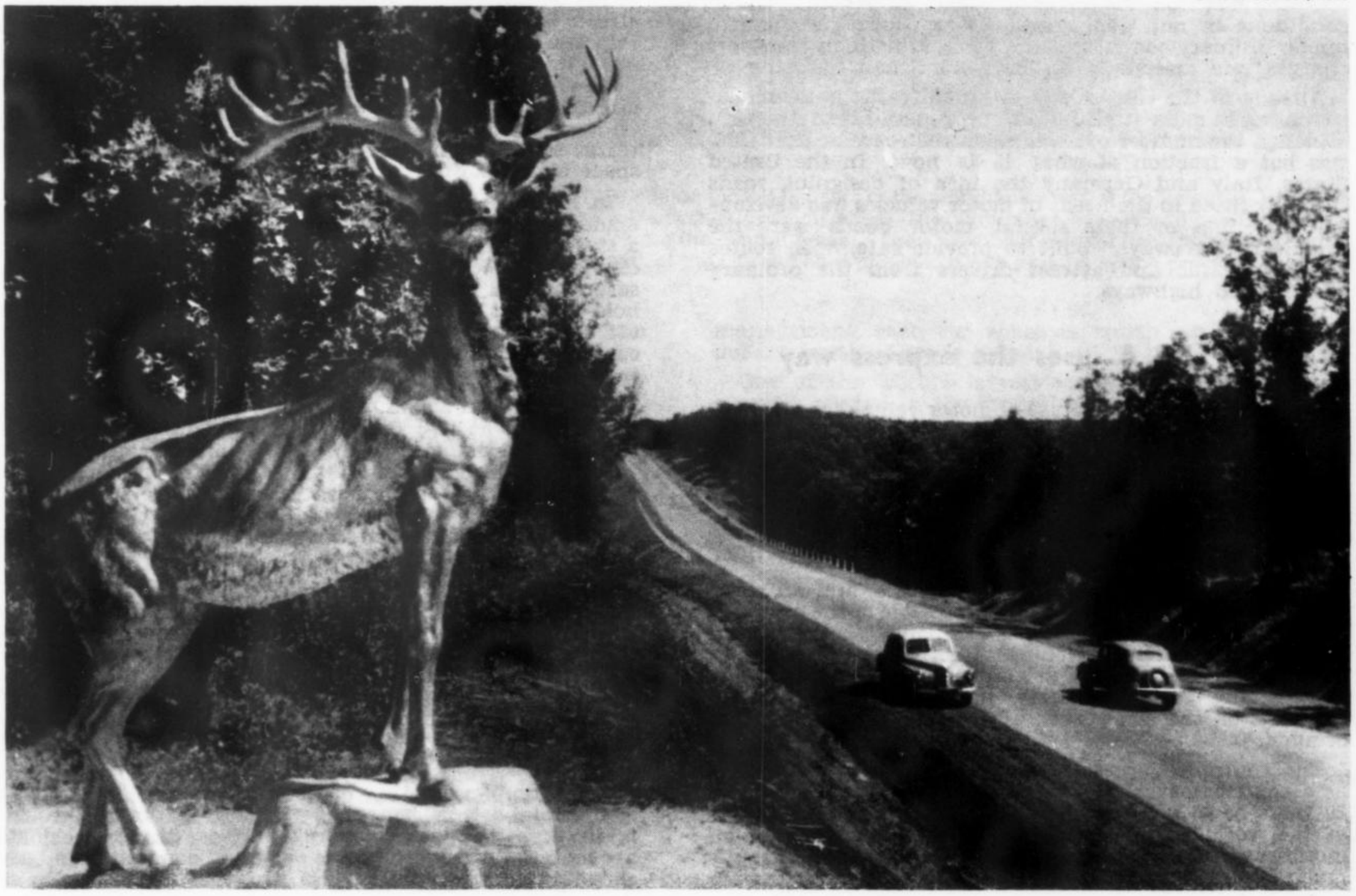
Once the roads have been linked from country to country, efforts will be turned to the progressive modernization of the network as a whole. Thus the countries of southern Asia, once largely isolated from the outside world, will be able to develop their trade, will get to known their neighbours better, and will also share fully in the economic and social progress of a continent which has now turned resolutely towards the future.



Deutsche Zentrale für Fremdenverkehr, Frankfort

RIBBONS OF CONCRETE cutting through plain and wood bring economic progress yet rarely spoil the natural scene. Landscape architects adapted German autobahns to harmonise with scenery. Mare and foal near Munich to Salzburg Autobahn (above) are as undisturbed by passing of automobiles as is the effigy of a stag beside Kharkov to Rostov motorway in the U.S.S.R.

Official Soviet photo



CAN WE SOLVE OUR TRAFFIC BOTTLENECKS?

by Henri Walter

THE rapid and continuous growth of motor traffic during the first half of this century has created a major social problem in the second half. There are now more than 100 million motor vehicles in the world, operating most of the time in and around the large towns and cities. Millions more are added to the total every year, even allowing for replacements. Because of the great concentration of urban activity, and the preponderance of the motor vehicle over other forms of transport, traffic stagnation has for some years threatened the world's larger cities.

Living standards everywhere depend more and more on the increasing use of motor vehicles, and in many countries two-thirds of all goods are now distributed by them. So it is not at all surprising that streets designed in and for an entirely different age of transport should have produced a traffic situation that is already intolerable and that unless bold remedies are undertaken, may become rapidly worse.

Congested streets are responsible for an enormous waste of time and effort and, above all, incalculable human suffering and misery through daily traffic accidents. In the centre of London, where conditions are among the worst in the world, the cost of traffic jams is estimated at more than £200 million a year. Traffic studies made in many countries have shown that by far the greatest number of road accidents involving motor vehicles—75 per cent or more—occur in built-up areas where all types of traffic move in all directions. Ninety per cent of the casualties among pedestrians also occur in built-up areas.

Quite apart from the toll of accidents, present-day traffic conditions in and about cities slow down production, hinder ordinary commerce and, by creating high transport charges, add materially to the general cost of living.

Already in the early 1920's the road traffic problem was beginning to make itself felt in Europe and North America, although the number of vehicles on the roads at that time was but a fraction of what it is now. In the United States, Italy and Germany the idea of designing roads specially fitted to the needs of motor vehicles was developed. The first of these special motor roads were the American "parkways," built to provide safe, open routes for fast traffic and attract drivers from the ordinary overcrowded highways.

The U.S.A. uses the express way

ROADS for the exclusive use of motor vehicles were introduced into Europe by the Italians, but their early autostrade made no provision for dividing opposite traffic streams. It was in Germany and Holland, and also in the United States, that special motorways with separate carriageways and controlled access were built on a large scale. The German autobahn system, particularly, became a model of efficient highway engineering.

By barring pedestrians, cyclists, horses and all slow-moving traffic the motorway eliminates one of the principal causes of accidents, namely, the mixing together of all forms of road users travelling in different directions at different speeds. Drivers get on or off the highway only at specially designed safety junctions. There are no crossings on the same level, all other roads passing over or under it.

The controlled access highway is universally accepted as a contributory factor to traffic safety, and in the past 20 years or so such roads have been built in many parts of the world. While traffic speeds are much higher on motorways than on ordinary roads, accidents are usually much lower. Comparison of accident rates on motorways and ordinary general-purpose roads in Holland, for example, has shown the motorways are up to 75 per cent safer to use.

In North American cities, the building of controlled urban motorways, or expressways, has had a remarkable effect on the death rate in built-up areas. The U.S. Bureau of Public Roads has estimated that the fatal accident rate on highways built to expressway standards is 2.8 per cent for each 100 million vehicle-miles travelled, compared with 10.1 per cent for other roads in the same areas carrying similar traffic.

For a time motorways were built primarily to speed up traffic *between* important towns and cities. But it was realised such "traffic pipelines" were needed most of all in the cities themselves where congestion was far more serious. American highway engineers who pioneered urban motorways borrowed ideas from the railways. Trains proceed at fair speed without obstruction through the most densely built-up areas because the tracks are set apart, above or below street level. Why, then, argued the expressway planners, should through motor traffic not be similarly segregated ?

Brussels builds an aerial highway

SO in large cities all over the United States, in Europe Latin-America and elsewhere, spectacular motor roads carry large volumes of motor traffic swiftly and safely across crowded city centres. Elevated highways stride on steel and concrete viaducts high above shopping streets, market places, rivers, canals and railway yards. Depressed motor roads run in cuttings, or underpasses, below bridges taking the ordinary local street traffic. In some cities the double-deck highway has been evolved as a means of carrying the maximum flow of traffic through an area where the land space is very restricted. Opposite traffic streams run one above the other, while the covered space under the decks is used as a car park.

In Brussels, where extensive street improvements were made in time for the 1958 World Fair, cars now drive at a steady 30 or 40 miles per hour from the outskirts of the city into the centre. On the main road round the centre, seven tunnels were dug at cross-roads to eliminate traffic hold-ups. At one end of the road traffic suddenly "takes off" on to a 1 1/2-mile long viaduct built on stilts to carry cars going in and out of the city above the "local" traffic below.

The most spectacular tunnelling feat is a series of fly-unders built at the Porte Louise junction. There, one tunnel was built at right-angles underneath another tunnel. A third tunnel links up the other two, while the existing road at street level is reserved for trams and local traffic. Through traffic in any direction uses the tunnels which have rid Brussels of what was once a notorious blackspot for hold-ups.

At Rotterdam, too, one can drive through the city on a fast sunken motor road giving through traffic direct access to and from the fine modern highway tunnel under the River Maas. And in Warsaw the new east-west traffic route passes in a series of tunnels under the old city centre. These are just examples from a large number of cities in Europe which are tackling their traffic problems in a constructive way by building new roads to fit present and future needs.

Every road user—the pedestrian, cyclist, motorist or commercial driver—benefits by the segregation of through traffic from the local, stopping traffic. Street accidents are materially reduced by the easing of congestion in busy shopping centres, while such essential local traffic as

USIS

KEEPING OUT OF TOWN. There are now more than 100 million motor-vehicles in the world and most of the time they are using the streets of large cities. In Los Angeles—one of America's fastest growing cities—the authorities have found one answer to the problem of keeping as many vehicles as possible away from the central areas. They have built a new business centre (above) about six miles away from the overcrowded streets in the heart of the city and have provided it with parking space covering 14 acres.

passenger vehicles and tradesmen's delivery vans can operate more efficiently and economically.

While traffic segregation goes a long way towards removing congestion in cities, the problem of the parked vehicle still remains. In every large city or market town more and more cars converge on the centre each working day. Available parking space is outgrown and vehicles parked at the kerbside greatly reduce a street's traffic capacity and indirectly cause accidents.

The problem that municipal authorities face is how to provide sufficient off-street parking in or near to built-up city centres. One solution is the multi-storey parking garage which accommodates the maximum number of vehicles on a minimum of ground space and affords drivers quick and easy parking. Such garages have been developed with success in a number of European and American cities.

Managements of large city stores are finding it worthwhile to provide convenient parking accommodation for customers who drive in from the surrounding suburbs or outlying districts, and in America the tiered parking terrace is becoming something like a standard annexe to the leading departmental stores. One such store in Salt Lake City, for example, has reported an increase of nearly 20 per cent in sales since it built on a parking terrace for 500-600 cars five years ago. According to the management, each car space is worth an extra 3,000 dollars worth of trade a year.

One of the world's largest store parking garages was recently opened in the central shopping area of London. Attached to a famous departmental store, the garage accommodates 1,000 cars on seven floors, reached from street level by a continuous ramp. There is direct access for shoppers from each parking floor into the store and the basement of the new building serves as an underground marshalling yard for the store's own fleet of goods delivery vehicles.

Coventry—centre of the British motor manufacturing industry—like Rotterdam, suffered wholesale destruction through bombing raids in the last war. In both these cities, which have been extensively replanned and rebuilt, "traffic-free" shopping streets have been developed. In this new conception of city planning, store premises are served by rear-access roads and the usual street carriageway in front of them is replaced by spacious paved areas, laid out with gardens and ornamental features. Arcaded footpaths and pedestrian subways are provided to allow families to shop in safe and pleasant conditions. The traffic-free shopping centre is another and very important contribution towards the reduction of street accidents in busy, congested cities and is likely to be developed on a world-wide scale in the future.

WHOSE FAULT IS IT?

WHO

ROAD travel is the most dangerous form of transportation in Europe today. This is clear from a report of the Economic Commission for Europe dealing with the prevention of road accidents, which suggests that even greater casualty figures can be expected unless prompt action is taken.

The report reviews the main causes of fatal accidents and injuries on the roads and gives a breakdown of the factors responsible. It reveals the striking fact that the risk of death on the roads of Europe for a given distance is ten times that involved in travel either by aircraft or train.

Figures quoted for every 100 millions of kilometres travelled by road vehicles were: 18 people killed in Western Europe, 10 people in Great Britain and less than five in the U.S.A.

What are the causes of these road accidents? Are faulty vehicles the chief culprits?... or faulty roads?... faults in the traffic control?... or just plain, faulty human beings? There are many contradictions and discrepancies in the reasons given. Figures from one country incriminate the bad state of highway surfaces; these from another blame faulty automobile brakes. One reason for this is that different reports may record different opinions as to the cause of similar types of accidents.

This is often true of a typical accident—the collision of two vehicles at a cross-roads where visibility is poor. The driver coming from the left (the example here applies in France, where drivers coming from the right have priority) would in all likelihood be blamed by the police for entering the cross-roads at an excessive speed.

A traffic specialist might object that the speed in question (say 20 m.p.h.) was not excessive in view of the fact that the automobile was designed to travel at speeds between 30 and 55 m.p.h., in normal conditions. The accident, he would say, was due to the limited visibility at the cross-roads. Suitable for the age of ox or horse-drawn transport, the cross-roads is quite inadequate for the modern vehicles now using it. His conclusion would be that the State was to blame for not making the necessary changes. Which view is correct? In reality the views expressed in both cases are subjective ones.

It is, however, possible to get an idea of the share borne in accidents by faulty roads. German studies of the country's autoroute system, for example, have led to the conclusion that road improvements could halve accidents on these highways.

Faulty vehicles are on the average only alloted a low percentage (5%) of responsibility for accidents.

What about the faulty human being? In Italy, the "Ispettorato della Motorizzazione Civile" examined 2,000 road accident cases in which there were almost always fatal results. The study showed that accidents due to human error amounted to over 52%; to faulty vehicles, 7% and to faulty roads, 40%.

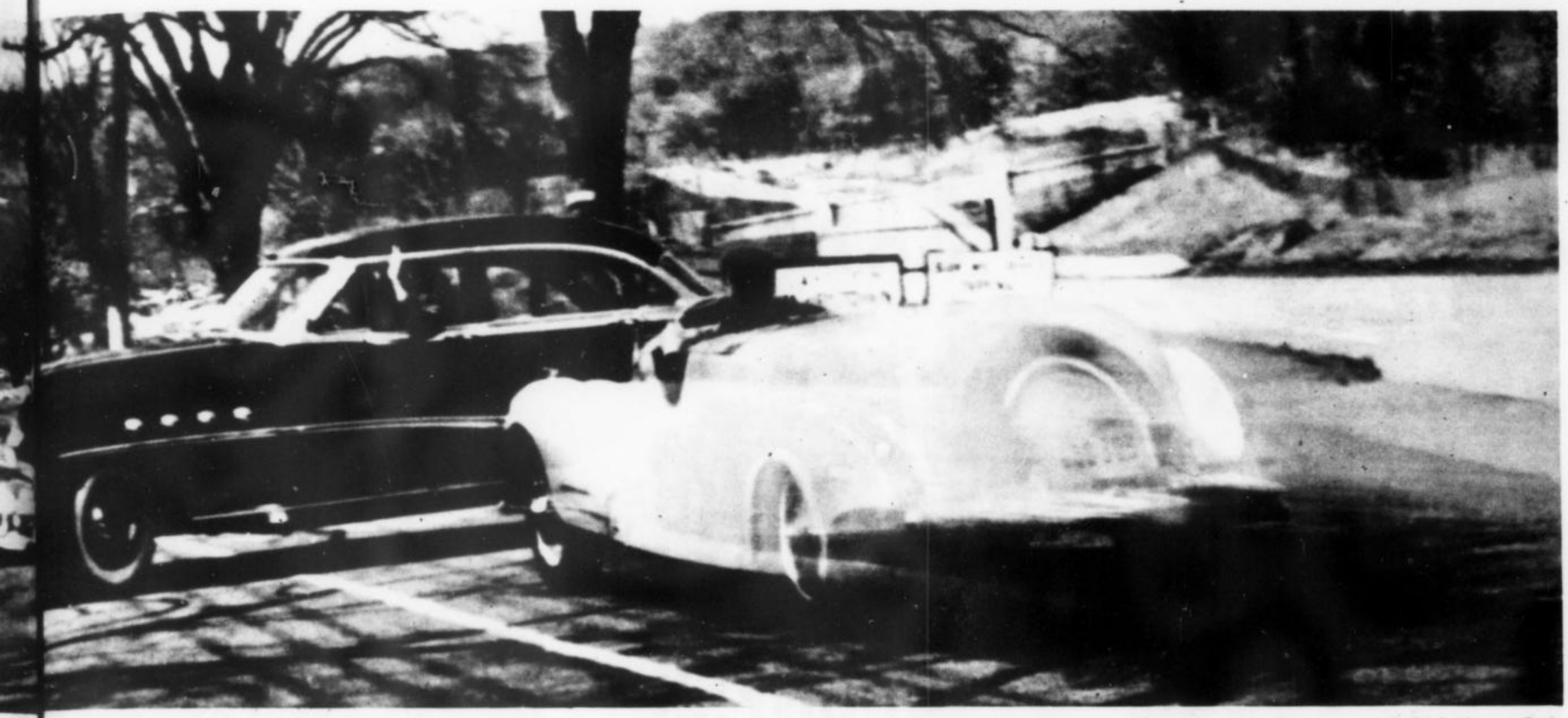
The point has been made, regarding the comparison between autoroute accident rates and those on ordinary roads in Europe that the large number of accidents involving cyclists and pedestrians on these roads is due to the very fact that they are allowed to carry traffic of such a mixed nature. In other words the fault is not with the pedestrian or the cyclist as much as the inadequacy of the road itself.

It has been estimated that proper road development would bring down the (roughly) 30% of accidents attributed to cyclists and walkers to as low as 5%.

In round figures, accident responsibility on the roads of Europe could be defined, on the basis of available figures, as follows: faults of motor vehicles drivers, 20%; faults of cyclists and pedestrians, 5%; faulty vehicles, 5%; faulty roads, 70%.

Better Living Through Better Roads

Readers who wish to read more about international (and national) road problems may be interested by two magazines which are specially devoted to these questions. The first is "Road International" which is published quarterly by the International Road Federation Ltd., of Abbey House, Victoria Street, London, S.W.1. The aim of the magazine is that of the Federation: "Better Living Through Better Roads". Orders for "Road International" may be placed directly with the International Road Federation or through a newsagent. Each issue costs 3/6d or 50 cents. Annual subscription rates (post free): United Kingdom 14/-; U.S.A. $2.00; France 700 frs. The second magazine, published monthly in French, is "Etudes Routières", which offers news and views on the economic and technical aspects of road building and use around the world. Price per issue is 7/- or $1.00; annual subcription, £3. 10. 0. stg. or $10.00. Subscriptions can be taken out in U.K. through Barclays Bank, 168 Fenchurch Street, London E.C.3, or through "Etudes Routières", 17, rue Necker, Geneva, Switzerland, payment to be made by international money order or banker's cheque.



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ROAD SAFETY IS THEIR BUSINESS

1, 2, 4, 5, 6, 7. © Almasy, Paris.
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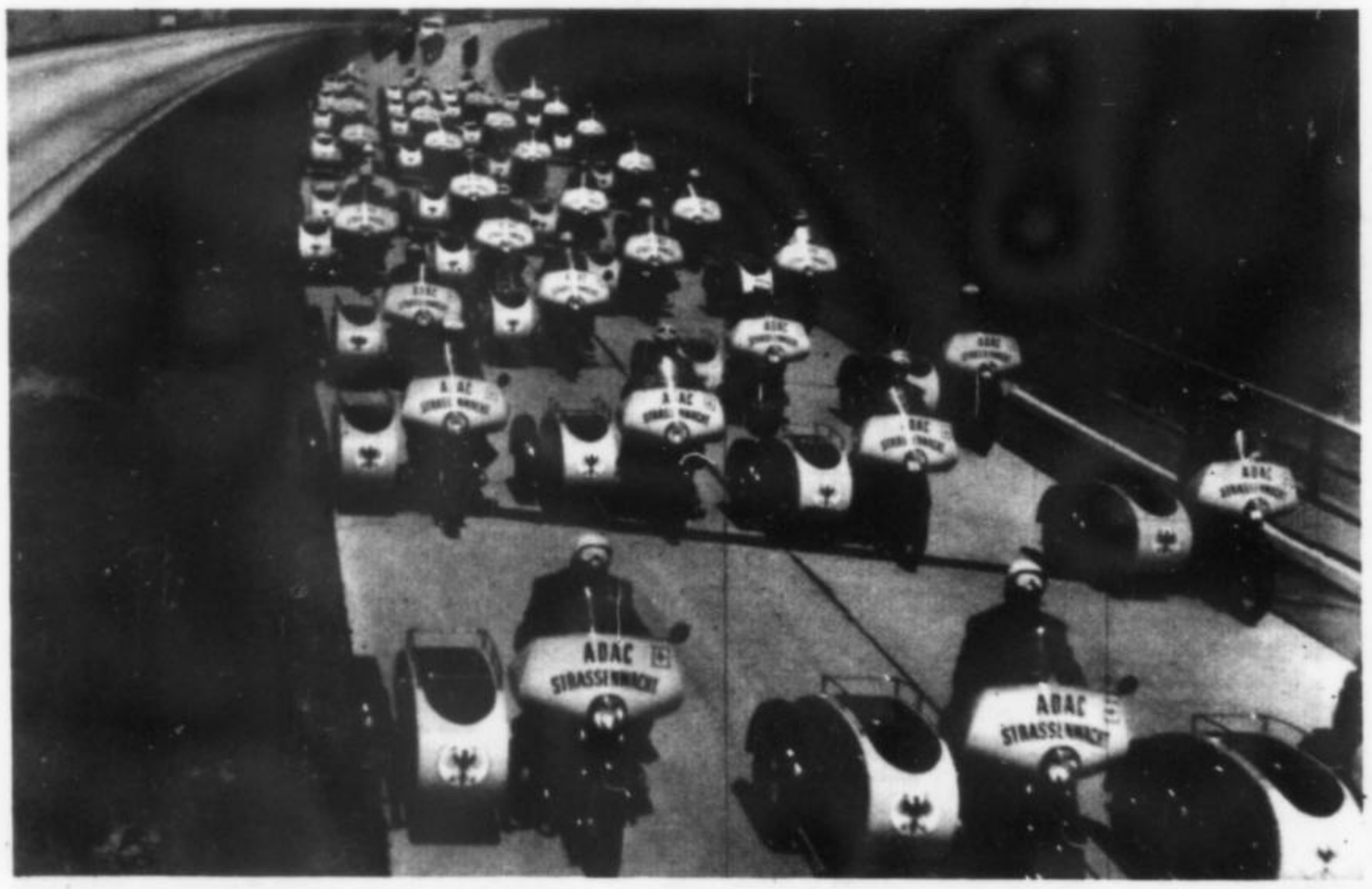


A familiar figure on the world's roads—in city street or on national highway —the traffic policeman does a vital job: seeing that road users obey the highway code, directing traffic, and, when needed, lending a hand to the motorist in distress. On these pages we present some traffic policemen

to the licemen

from widely separated parts of the world. On duty at a busy city intersection in India or on horseback patrol in the Argentine, the traffic policeman is doing a vital job of work. 1. Pakistan. — 2. Argentina. — 3. German Federal Republic. — 4. Greece. — 5. India. — 6. France. — 7. Sweden.

Deutsche Zentrale für Fremdenverkehr

BY BARRING CYCLISTS, pedestrians, horses and all slow-moving traffic, the motorway eliminates one of the principal causes of accidents, namely, the mixing together of all kinds of road users travelling in different directions at different speeds. Photo shows part of the Alpenstrasse in Upper Bavaria, a picturesque road linking Munich and Innsbruck across the Bavarian Alps.

PEDESTRIANS, LOOK OUT!

PEDESTRIANS in the over 65 age group are nowadays the chief victims of fatal traffic accidents and the mortality rate is still increasing. An increase of one hundred per cent or more in the mortality from traffic accidents among pedestrians in this age group occurred in some countries between 1950 and 1955. The death rate for young pedestrians, however, rose much less in some countries and even decreased in others, according to a study by the World Health Organization (WHO) covering 18 countries.

A comparison of the average annual figures for the period 1950/52 with those for 1953/55 shows that in most countries the number of pedestrians killed per million motor vehicles has dropped; that countries with the sharpest increase in road traffic have the highest rate in fatal accidents, and that there are far more men than women among the victims.

The greatest increase in the death rate of pedestrians over 65 years of age has taken place in the Netherlands where it rose from 40.5 annually per million inhabitants to 96.8—an increase of 139 per cent, while the increase for all ages was 69.6. Increases were noted in five other countries, in the following order: Norway, Japan, Union of South Africa and Denmark. During the same period (figures for 1950-52 compared with those for 1953-55) the increase in the United Kingdom was from 154.1 pedestrians aged over 65 killed per million inhabitants to 178.9—an increase of 16 per cent.

The only countries where a decline in mortality has taken place are the United States of America (12.8 per cent less for those aged over 65; 13.4 per cent for all age groups) and Ireland (7.3 per cent and 5.9 per cent respectively).

Of all countries covered by the study, Japan has the highest overall rate of traffic deaths with an annual average for the period 1953/55 of 2,336 pedestrians killed per million motor vehicles compared with 129 in the U.S.A. where there are many fewer people walking on the roads.

Here are the average annual figures in 1953/55 for 16 countries covered by the study.

Countries	Inhabitants per motor vehicle	Pedestrians killed per million motor vehicles
Japan	67	2,336
Spain	91	1,283
Italy	14	1,272
Finland	24	861
Switzerland	10	534
Norway	14	416
Ireland	14	405
United Kingdom	8	390
Denmark	10	363
Netherlands	12	338
Sweden	8	316
Australia	5	309
Canada	4	291
New Zealand	4	153
Union of South Africa (European population only)	3	145
U.S.A.	3	129

DRIVERS WATCH YOUR SPEED

THE assessment, of the various degrees of responsibility for accidents involving injury or death on the roads of Europe gives first place (70 per cent) to faulty roads and allots less than a third of this percentage (20 per cent) to the drivers of vehicles themselves. A 20 per cent responsibility, however, is still a responsibility for one case in every five.

What can be done to improve standards of driving?

An expert makes the following point: "The results of road safety teaching to schoolchildren are striking. Countries which have made the greatest efforts in this direction have declared that the number of road deaths among children has become stationary or has even fallen... while the number of adult victims of road accidents has continued to increase at a rate roughly equal to the increase in circulation."

His suggestion is that what is good for children should be equally good for adults, that "preaching" at people will get us nowhere and that what is needed is simple instruction and information.

In this connexion readers who are drivers of motor vehicles may be interested in some figures published by a French car manufacturing firm and circulated to users of their cars.

The first comment made is that the average driver might drive more carefully if he would learn to think of his speed not in terms of miles an hour but in *feet per second*.

Consider the figures:

Miles per hour...	equals ...	feet per second
87		127
37		55
15		23
12		18

Emergencies on the road call for action in terms of seconds and split seconds. It is therefore realistic to consider speed—which reduces time available for action—in terms of seconds.

Second comment: Road safety might improve if drivers would think less of the time taken to get from A to B and *more about the time taken to stop a car in motion.*

A motorcar moving at 62 miles an hour is covering 92 feet *every second*. An obstacle appears. It is estimated that normally about half a second passes between a driver seeing the obstacle and applying the brake. In the half second the car has already covered 46 feet.

If the road is good and dry, *IF* the car's brakes are efficient and the tyres in new condition, *four more seconds* are required before the car stops. In those four seconds *it will have travelled a further* 188 *feet.*

To sum up: 62 miles an hour to a stop takes five seconds in all, during which time the car *cannot be prevented*—unless it hits an obstacle—*from travelling a distance of more than* 230 *feet.* On a wet road, and with worn brakes, this distance may be increased to as much as 650 feet.

Note for those who like even an occasional drink while "out for a run": alcohol, even in small quantities, has two effects on a car driver. The first is that he tends to drive faster, the second that his "reaction time"—the time betweeen his becoming aware of an obstacle and his taking action to stop or avoid it—is increased. Read the above paragraphs once more.

Third comment: instead of thinking about how powerful the car engine is, *drivers would be wise to think instead how powerful their brakes are.*

Consider the following facts:

Suppose that a car of 55-60 BHP weighing 1,000 kg, is moving at a speed of 30 miles an hour. The driver can double its speed within 17 seconds. Suddenly, a lorry swings across the path from a side-road. Down goes the brake pedal. *IF* the road surface is good, *IF* the brakes are efficient, the car can be brought to a standstill within 4 seconds. This means that a retarding force of 190 HP has had to be applied—*equal to three times the engine power of the car.*

Yet despite all the mechanical strains and stress on motor vehicle mechanisms, the share of *faulty vehicles* in the toll of injury and death on European roads is put at only 5 per cent... four times less than that attributed to faulty driving.

ROAD SAFETY CAMPAIGNS inspired by the urgent need to reduce the heavy toll of accidents—especially in towns, where 75% of those involving motor-vehicles occur—are being given ever greater prominence. Public authorities and accident prevention societies remind the public to "take care", with posters like those shown here, from, left, Great Britain and right, the Netherlands.

Longest road built:

THE ROYAL HIGHWAY OF THE INCAS

by Jorge Carrera Andrade

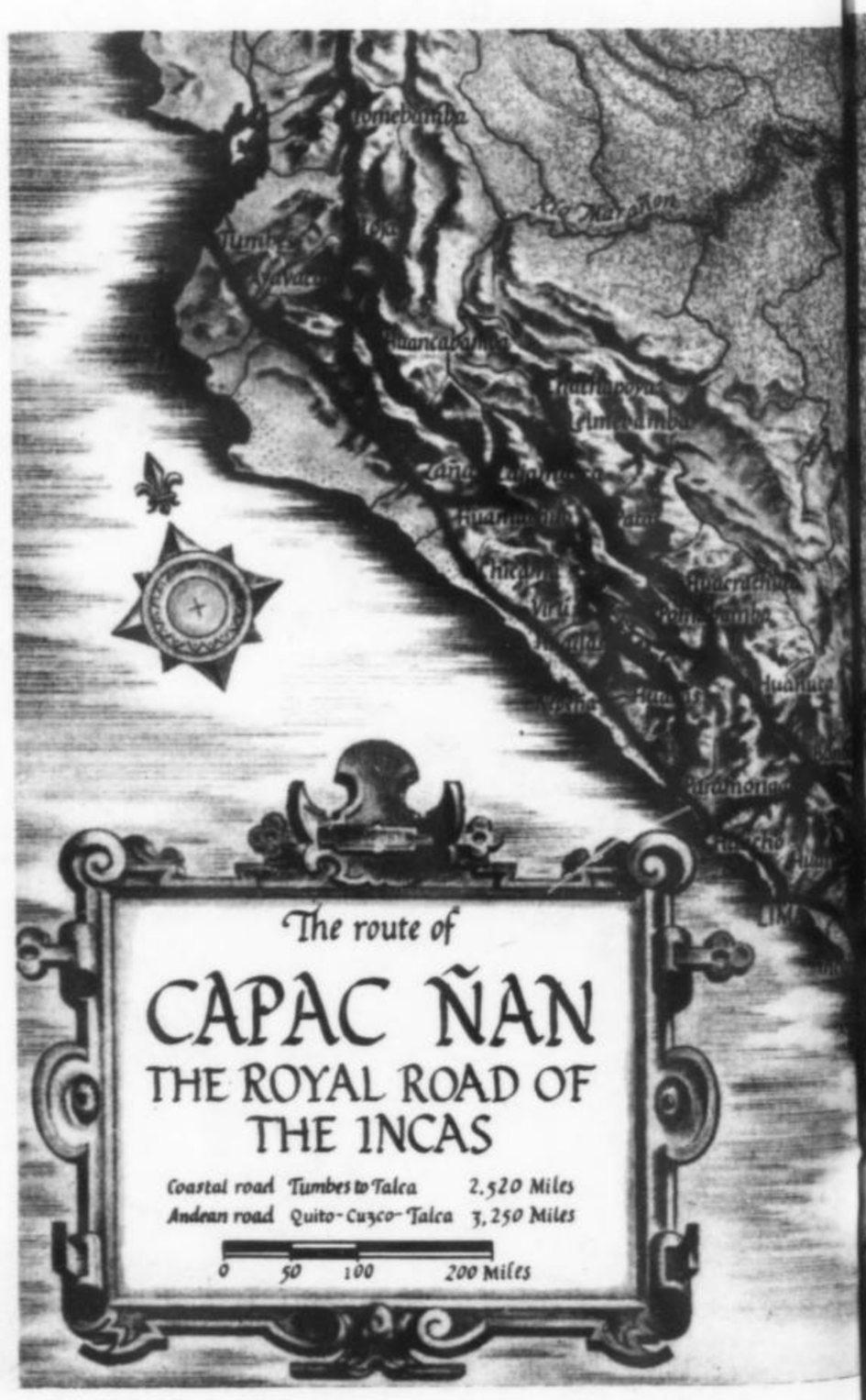
HANGING BRIDGES, "little brothers of the roads", were ever important links in the Inca road system. They were constructed of bamboo and fibre cords—some of this type still exist in South America—and their upkeep was entrusted to a "Commissioner of Roads and Bridges" a sketch of whom (left) was made by Guamán Poma de Ayala, the chronicler of Indian descent in his 17th century Codex, "Nueva Crónica y Buen Gobierno". With its drawings of bridges and royal halting stations, this work constituted a kind of illustrated guide to the Inca roads as they existed in the 17th century.

THERE are many paradoxes in history, and one of the strangest is surely that the Incas, who had never heard of the wheel, should have built the greatest road system the world has known. Their network of highways covered some 10,000 miles, stretching from Colombia all the way to Chile and from the shores of the Pacific to the jungle forests of the Amazon, crisscrossing almost all the territory now included in the Republics of Ecuador and Peru, as well as portions of Bolivia, Chile, northern Argentina and southern Colombia.

The Inca Empire began as a tiny kingdom on the shores of Lake Titicaca about the year 1,000 A.D. For five hundred years it grew and expanded until, after conquering the Kingdom of Quito, it was the most powerful civilization of South America and adopted the name "Land of the Four Quarters of the World" (Tahuantinsuyu) to signify its control of the four cardinal points of the compass.

The Inca road system was built to preserve the unity and safeguard the economic life of the Empire. Its construction is one of the wonders of human history, defying all natural obstacles in one of the most rugged terrains existing anywhere in the world. Though far less known than the celebrated roads of Rome and other ancient empires, the Inca highways are in many ways even more remarkable.

The backbone of the network was a broad highway—the "Great Royal Road of the Incas"—running the entire



Jorge Carrera Andrade of Quito, Ecuador, has done considerable research into the ancient civilizations of South America. He is the author of two books on the Incas and the Kingdom of Quito, "La Tierra Sempre Verde" (The Evergreen Land) and "El Camino del Sol" (Road of the Sun). A leading poet of Latin America, his literary works have been published in several languages. Since 1954 Carrera Andrade has been in charge of the Spanish edition of THE UNESCO COURIER.

length of the Inca Empire from north to south, between the two branches of the formidable Andean mountain range. In certain places the road rose sharply to as much as 15,000 feet; in others it dropped steeply in mountain valleys and gorges, traversed broad fertile plains and bleak stretches of desert wasteland.

From the main highway branch roads cut through the mountain in all directions, especially to the west, where they linked up with another mighty highway known as the "Coastal Road", which ran parallel to the Great Royal Road along the sandy coastal plains and forests from Tumbez to the north of Chile where it joined up with it.

It should not be imagined that the Inca roads were mere mountain tracks or desert trails. The Great Royal Highway was 25 feet in width and ran straight as an arrow, without curves or detours of any kind, for 3,000 miles—more than the distance between Gibraltar and Moscow! Paved with stones along almost its entire length, it traversed only the principal cities of the empire, like Cuzco and Quito, the other towns being linked up with the Royal Highway by secondary roads. On both sides of the highway the Incas built walls of stone and packed earth on top of which they planted agave cactuses at regular intervals. In addition rows of trees lined the road to provide shade for travellers. Living in a bleak landscape the Incas attached great importance to their trees and the empire enacted stringent laws for their preservation. The penalty for cutting them down was death.

Along the side of the Great Royal Road ran a rivulet of fresh water to quench the thirst of both wayfarers and draft animals. At intervals of about twelve miles along the entire stretch of 3,000 miles there were wayside houses known as *tampus* where travellers could rest or spend the night. There were also chains of granaries and royal depots stocked with food and all kinds of supplies for the army, including clothing and leather footwear. Grain and manufactured products were stored in huge earthen jars. Strangers were accommodated with the utmost hospitality in hostelries called *corpahuasis* and were provided with food and drink free or charge.

Every mile or so along the Royal Route the Incas built edifices for a special category of imperial functionaries, the *chasquis* or relay couriers, who raced on foot from one end of the kingdom to the other bearing royal messages by word of mouth. Sometimes messages were conveyed by specially painted sticks or beans painted in various colour combinations which had specific meanings. The Incas resorted to these devices since they had no written language.

This postal service was so efficient that it covered the 3,000 odd miles of the Great Royal Highway in a matter of 20 days or so—four times faster than the "pony express" service introduced by the Spaniards after the Conquest. In the best season of the year, the *chasquis* covered the distance between Cuzco and Quito in five days—a feat they continued to perform clandestinely during the Colonial era to the amazement of the Spaniards who dubbed this fleet-footed news-transmission system "post office of the sorcerers."

"Highway of the Sun" © Victor W. von Hagen-Duell, Sloan & Pearce, N. Y.

The stone that wept blood

THE astounding network of Andean roads and highways was the achievement of three Inca emperors: Pachacútec, Túpac Yupanqui and Huayna Cápac, the manpower for the construction work coming from the tribes of peoples they subdued. Pachacútec, known as the "Reformer", was particularly fond of stone and for the Royal Highway he had enormous blocks of stone transported hundreds of miles, particularly from the Kingdom of Quito, using the Indians of that region and a tribe called the Chancas. The treatment meeted out by the imperial guards (they were called Big-Ears) was such that the Indians finally revolted and almost overthrew the Inca kingdom. The earliest chroniclers relate how the huge stones (some weighing 10 tons) were carried such great distances and tell a story of how one such block fell and crushed a thousand Indians to death. It passed into legend as "the stone that wept blood."

Fifty years after the Conquest, a Spanish missionary, José de Acosta, visited the New World and noted that the Indians who worked on the roads "used no mortar, had neither iron nor steel for cutting and working the stones, no machines or instruments for transporting them, yet so skilful was their work that the joints between the stones were barely noticeable."

Túpac Yupanqui was the son of Pachacútec and carried on his father's work. He extended the Royal Highway as far as Chile in the south and beyond Quito in the north, thus opening up new territories for trade and development. To consolidate the empire he built a chain of fortresses near the Great Highway, and instituted a system of "population transfers", shifting newly conquered tribes to Peru and replacing them by loyal subjects.

Huayna Cápac, his successor, surpassed his father in the field of public works. He built Temples of the Sun and Inca Watchtowers along the Royal Highway. He repaired the old roads and built new ones, and had platforms and terraces made to prevent erosion of the soil.

But above all, Huayna Cápac was responsible for the repair, strengthening and consolidation of the suspension bridges. These bridges are one of the greatest feats of the Inca road network. They appear frail and delicate but proved astonishingly resistant. Flung across raging torrents and formidable mountain chasms, they were made of six-inch fibre and bamboo cables anchored into stone piers, and were covered with a floor of wooden laths solidly lashed together to resist the wind and other ravages of the elements.

Alexander von Humboldt was one of the many explorers who gazed in awe and amazement at the Inca suspension bridges. His description of one of them—the Bridge of

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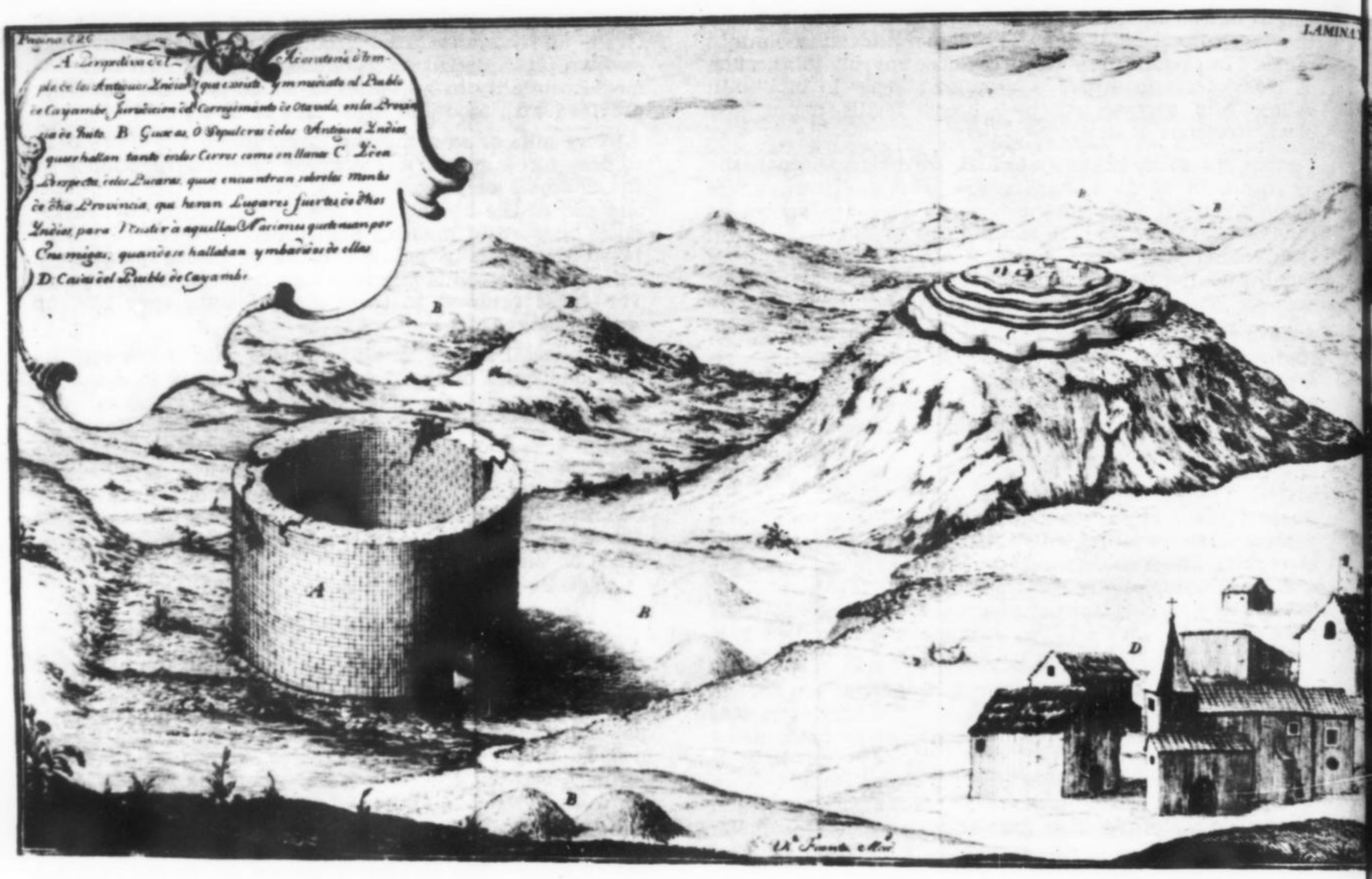

INCA HIGHWAY

(Continued)

San Luis Rey—was the source of inspiration for novels by Thornton Wilder and Prosper Mérimée. Humboldt considered the whole Inca road system far superior to that built by the Romans in Italy, France and Spain, and pronounced them "the most stupendous and useful works ever executed by man."

But the Incas' passion for roads went much further than building and engineering. They also set up a smooth running system of road maintenance. A "Royal Commissioner of Inca Roads and Bridges" supervised a staff of road inspectors whose duty it was to tour the realm and check on road conditions and on the toll-gate keepers controlling the heavy traffic of llama trains laden with produce. Large crews of *yanakonas* were always on hand to sweep and clean the paved highways with brooms made of vegetable fibre. Yvar Lissner did not exaggerate when he said (in his book *How Our Ancestors Lived*) that at the time when the roads of Europe were no more than muddy, pot-holed ditches, the Incas had the finest highways anywhere in the world.

Surpassing Hannibal's Alpine road

THE 16th century saw the Great Royal Highway converted into a major artery for violence and bloodshed. The Spaniards who landed in Ecuador bent on conquering South America, found the vast Inca communication network ideally suited for the quick seizure of the great empire. Captain Pedro Cieza de Leon, writing between 1533 and 1545, was the first European to give a detailed description of the Inca roads "which surpass those of the Romans as well as the road Hannibal built over the Alps."

As they penetrated the land of the Incas, the Conquistadores stared at the scene they saw with incredulous amazement: down the wide, spacious highway came groups of Indians carrying hammocks or litters containing personages of note. Other Indians drove trains of llamas laden with sacks of coca leaves or ears of corn. The very sight of these animals—half ewe, half ass—left the Spaniards open-mouthed.

It soon became clear to them why the roads were in such excellent condition: the only traffic on its paved surface consisted of sandal-shod pedestrians and gentle-footed llamas. Later, when the Conquistadores landed horses in the country (the Incas had never seen any before) their iron-shod hooves and the wheels of the heavy oxcarts were to cause havoc to the Llama Road and irreparably damage the Great Royal Highway of the Incas.

Their conquest completed, however, the Spaniards realized the advantages of the Inca road system and tried to preserve it by following the Indian example, at least in part. They adopted the llama caravans for carting off the gold they collected either as booty or tribute or which they extracted from the mines. Soon, long caravans of Indians, columns of Spanish soldiers and llamas could be seen heading for the coast where the precious metal was stored aboard the Fleet of the Indies for shipment to Spain.

The Inca road system was thus not only an artery of blood but also of the gold of South America which went to raise the standard of life of Europe and to add splendour to the Renaissance. An official chronicler of the time, Leon Pinelo, estimated that 3,420 million gold doubloons flowed into the coffers of Spain from the land of the Incas.

The Royal Highway of the Incas, which cannot be dissociated from the llama, the postal network, the granaries and roadside inns, was in fact the direct instru-

© Almasy, Paris

THE MIGHTY ROAD through the Inca Empire, running straight as an arrow for more than 3,000 miles from Colombia to Chile, was one of the greatest achievements of road engineering in history. Monuments, fortresses, resting places for travellers temples and other buildings were erected along the great highway. Drawing (opposite page) showing a section of the road and buildings, was made about 1740 by Antonio de Ulloa, a Spanish geographer near to the village of Cayambe in what is now Ecuador. Photo (left), taken recently in Bolivia, and engraving (below) illustrate the contrast between road travel then and now in this part of the world to which the wheel was introduced many years after the arrival of the Spaniards, who at first made use the llama caravans for carting off the gold they collected for shipment to Spain.

Engravings — © Bibliotheque Nationale, Paris.

ment in the economic expansion of the Inca State (Inca society vested the entire wealth of the soil and sub-soil in the State and there was no private ownership of land). As a result of the later neglect of the Spaniards, the inefficiency of Colonial organization, the ravages of time and above all, the excesses of the *encomenderos* (settlers) who used the Inca roads as a quarry for the stone they sought for their building, the whole highway network finally disintegrated.

Nevertheless, traces of this unparalleled feat of engineering still remain today. In the course of numerous journeys through Ecuador, I have personally come across vestiges of the Inca Highway on several occasions in the provinces of Imbabura and Pichincha. A Spanish geographer, Antonio de Ulloa, visited this region in the 18th century and has left us a detailed description of the Highway, the watchtowers and the fortresses built by the Incas (See drawing opposite page).

Little reed horses to cross the lakes

In the picturesque Imbabura Lake region, the Incas supplemented their road network by a fleet of small reed boats and these are still to be seen in use today (the Indians refer to them as "little reed horses"). The Azuay region of Ecuador provides proof of the amazing solidity of the Inca Highway and of the skill with which the stones were fitted together. Despite the passing of centuries, and notwithstanding the continual, torrential rains prevalent in the area, water has not succeeded in filtering through the joints between the stones. Instead, the water has hollowed out a channel *beneath* the blocks of stone and flows away like a river under the arches of a bridge.

Further evidence of the Incas' skill, foresight and practical turn of mind is seen in their secondary roads which served as supply lines for the products vital to the kingdom. Thus Huayna Cápac built a road from Quito to the Coca valley in the eastern slopes of the Andes for the transport of the prized coca leaves; another road knifed through the mountains to the coast and became the supply route for shrimp and other sea food. This coastal road also supplied platinum, mined in the region, and salt extracted from the nearby island of Amortajada close to the coast of Ecuador. Another road, running laterally from Cuzco to the coast, made it possible to have fresh fish (considered one of the greatest delicacies) in the Inca capital within two days.

A striking example of the ingenuity and foresight of the Inca engineers is visible today near Macusani in the Carabaya gold country northwest of Lake Titicaca. In his book on the Inca roads, *Highway of the Sun*, Victor von Hagen describes how the Royal Road climbs to a

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THE PAN-AMERICAN HIGHWAY—threading its way among peoples, scenery and climate as diverse as any on earth and extending some 15,000 miles—sometimes follows the course of the ancient Inca roads. Above, a newly reconstructed stretch in Bolivia.

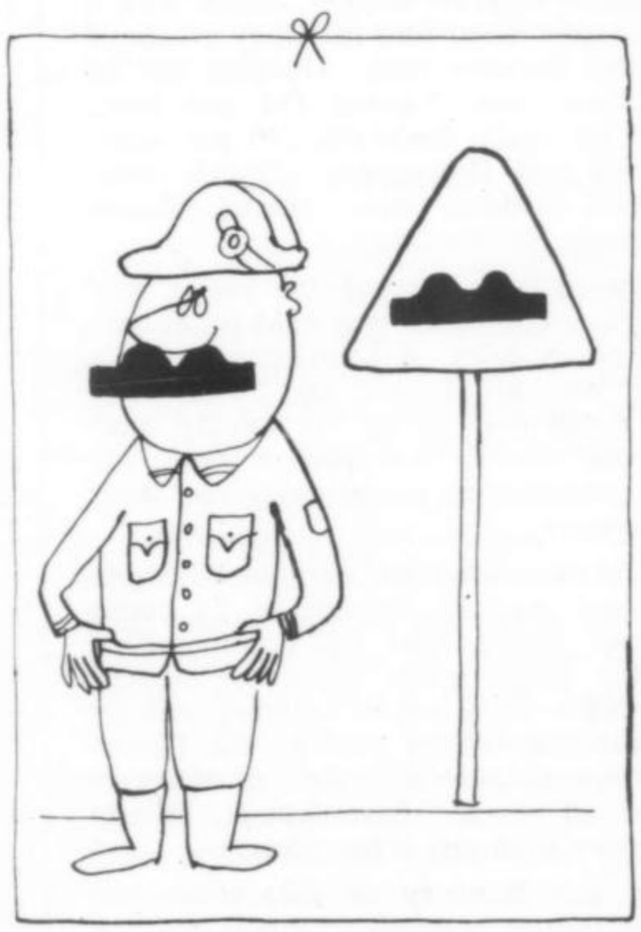
dizzying height of 14,800 feet and then passes under a glacier. "Here," he writes, "the engineers, anticipating the glacier's movement, had raised a retaining wall to catch the cascading rocks and to divert the snows high above the road. Here and there the eternal sweep and retreat of the glacier had sent rock crashing into and destroying a part of the road, but generally speaking it was in a good state of preservation."

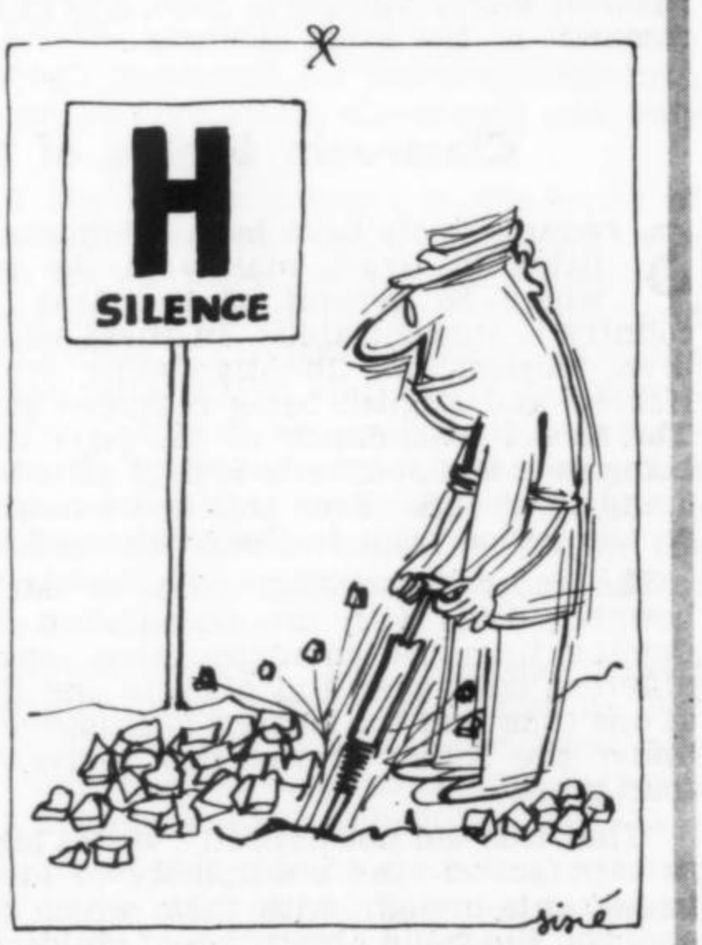
For centuries the Inca roads have aroused the interest, curiosity and admiration of scholars and travellers alike. But despite the fact that new information has been collected on the subject since the 16th century, many mysteries still remained unsolved. For example, we still do not know the meaning of the *apachetas,* the little mounds or pyramids found at intervals along the sides of the roads. The mounds are made up of stones which the Indians dropped there as they passed along the road. This custom has been attributed to some strange, inexplicable superstition. It may, however, simply have been a form of toll system by which travellers helped to transport the stone material needed for road maintenance. But whether the *apachetas* were an offering to some deity or the Inca people's contribution to the public works system no one really knows.

Recent explorations have brought to light the existence of a formerly unsuspected civilization on the Peruvian coast—the Land of the Chimus or "Kingdom of the Moon" (the Chimus, who included the Nazcas and the Mochicas with their fabulous pottery figurines, were worshippers of the moon in contrast to the Incas who worshipped the sun). The Inca's coastal Llano Road passed through the land of the Chimus and it was over this highway that the "Civilization of the Sun" of the Inca Empire came to the "Kingdom of the Moon."

The road started at Tumbez, the legendary City of Gold which the Conquistador Pedro de Candia was the first to visit and the riches of which he reported to Pizarro. The latter raised an expedition to seize Tumbez and the huge quantities of gold it harboured, but before the Spaniards could get to the city the Indians had emptied it of its riches in a spot which has yet to be discovered. The Spaniards entered a ghost town. Today it is nothing but a large rice field lying on the route of the Pan-American Highway, which incidentally, follows much the same itinerary as the old Inca Highway.

Despite the passing of centuries and the inclemencies of nature, the general lines of the Royal Inca Highway can still be discerned and stretches of it are still intact. The suspension bridges in particular have withstood the assault of time and are to be seen in Ecuador, Peru and Bolivia where they are in use in districts where the wheel is still unknown even today when the first man-made rockets are being shot toward the moon.





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LANGUAGE: KEY FACTOR OF INTEGRATION IN ISRAEL

by Pierre Vernier

FEW countries have had to face educational problems with such complications as those that have confronted the State of Israel in the last ten years. In 1948 the school population of Israel numbered some 100,000. Today there are over 500,000 school children and students, whose families have come from 60 different countries, who use more than 70 languages and who have ways of life and thought as varied as their tongues.

The measures taken to establish the educational system of this country have been the subject of a study published by UNESCO under the title of "Education in Israel" in a recent number of UNESCO's "Education Abstracts." The study, written by Mr. M. Avidor, Director-General of the Ministry of Education of Israel, reviews "ten years' effort" in the field of education.

Mr. Avidor points out that the salient factor in education in Israel is that "the school population has increased five-fold during this period, although the general population has barely tripled itself. This brought in its train serious problems of finding both buildings and materials. However, although at the beginning the situation was difficult, in the last two or three years it has improved considerably, each new village or community having a school of its own, even if only a modest one."

Another acute problem was the shortage of teachers whose numbers increased from 5,000 (1948) to 20,000 (1958).

During this period two major laws were passed affecting education. The first, in 1949, made school attendance compulsory for all children between the ages of 5 and 14. The second, in 1953, put most schools under State control and regularized the system of education in all schools. The period of compulsory education starts with a year in kindergarten and moves through the elementary schools. The young Israelis then have a choice of three types of secondary education: secondary academic schools under the control of the Ministry of Education and Culture ; secondary agricultural schools under the auspices of the Ministry of Agriculture or secondary trade schools supervised by the Ministry of Labour. Students continuing their studies can later proceed to one of three fine universities : The Hebrew University in Jerusalem which at the present time has six faculties—arts, sciences, medecine, law, agriculture and social science ; the Israel Institute of Technology in Haifa which concentrates on engineering and the Weizman Institute of Science at Rehovot which engages in pure, and in some cases, applied research in the exact sciences.

Classroom babble of tongues

SPECIAL schools have been established for young Arabs living in Israel, mainly in the region of Nazareth where 85 percent of the Arab population of the country is concentrated. In these schools the Arab children, Moslem and Christian alike, are taught in Arabic, Hebrew and English being regarded as second languages. The school attendance of the boys is very satisfactory, being over 90%, but only 50% of girls between the ages of 6 and 14 attend. Even this figure marks an improvement on the period prior to the creation of the State of Israel.

The most interesting part of Mr. Avidor's report, however, deals with the assimilation of the immigrants. Coming from 60 countries, they speak more than 70 different languages and dialects and there was a danger at one time that the Hebrew language would be submerged under the influx of the new arrivals—some 700,000 in four years.

"That this did not happen," writes Mr. Avidor, "was due to two factors—the multiplicity of languages which the immigrants brought with them which forced them to use one, and the rapid absorption of children into schools. In each school the children arrived speaking a dozen or more languages which made them turn quickly to a common language, Hebrew, in order to communicate with each other."

For the Israeli authorities, language is an essential factor in the integration process, and the first objective of the adult education programme, which is highly developed all over the country, is to teach Hebrew to the new arrivals. The Government, local authorities, labour organizations and various voluntary bodies conduct courses for adults, most outstanding of which are five or six-month intensive courses held in the so-called "Ulpanim."

Though Hebrew constitutes a common denominator of language, the problem still remains to find a common denominator of culture for such a heterogeneous population in such a restricted area.

So adult education aims at giving a basic education to new-comers who have never been to school and at the same time providing general training to people over 16 who seek additional knowledge and skills. Courses have been organised to this end all over the country and at all levels by the Government, by the General Labour Federation and by the Israeli Army which also performs a useful educational function.

To accomplish so difficult a task, the educators and leaders of Israel have used experimental methods and Mr. Avidor notes that they have achieved more successes than failures. This period of ten years has been long enough to show that great progress has been made in raising the cultural level of the new immigrants, particularly of the younger generation, and the results already obtained augur well for the future.

"Education in Israel" is one of a series of studies and bibliographies published by UNESCO on different national systems of education.

WHAT ISRAELI YOUTH READS

THE high literary standard of the books read by young people in Israel is revealed by a recent study carried out at the request of Israel's Minister of Education and Culture among 1,500 eleventh grade pupils (aged 16-17) attending 66 educational institutions.

Out of the 20 most widely read books, 16 were translations and four were original Hebrew works. More than a third of the young people questioned said that they preferred translated works to original Hebrew ones. Heading the list of favourite foreign authors was Tolstoy (32 per cent), followed by Cronin (22 per cent), Steinbeck (20 per cent), Pearl Buck (20 per cent) and Dostoievski (19 per cent). Among favourite Hebrew authors were Moshe Shamir (65 per cent) and S.I. Agnon (26 per cent).

The survey showed that 80 per cent of the books read by adolescents were novels. Top place was held by Hugo's "Les Misérables", followed in order of popularity by "The Diary of Anne Frank", "War and Peace" and "The Caine Mutiny". Researchers noted that all of the twenty most popular books were prose works, one quarter were war books, twelve had been published in recent years and three belonged to classical literature.

Forty per cent of students questioned were members of youth movements who had read an average of 56 books apiece compared with 44 books read by non-members. Secondary schools in the large towns have the highest average of reading: 71 books. In teachers' training colleges the rate is 60, in provincial secondary schools, 50. Classification of readers according to parents' countries of origin showed that the children of parents from Russia, Poland and Lithuania read far more than any other groups.

Following the survey, the Ministry of Education and Culture has decided to introduce compulsory home reading of books from a selected list in post-primary schools.

A NUCLEAR REACTOR NAMED WATER NYMPH

by Victor Hari

THERE are still people in India who have never seen a motor-car or an electric light bulb. On the other hand the first atomic reactor in Asia, outside the Soviet Union, was built entirely by Indian scientists and engineers at Trombay near Bombay and will celebrate its third birthday next August. Today India is the sixth atomic power in the world—not in terms of nuclear weapons but research.

Why is nuclear research so vital to the progress of India?

In the words of Dr. Homi Jehangir Bhabha, Secretary of the recently constituted Atomic Energy Commission of India: "Atomic energy is the new branch of technology on which the industrial revolution of the 20th century will be based."

For India this 20th century industrial revolution is particularly important. In two years, the population of the country will be 400 million and by 1975 it will amount to 500 million. India's annual per capita income is Rs.295 ($U.S.62) as compared to the American average of Rs.10,000 (over $ U.S. 2,000). Thus we have to run even to be able to stand still.

But what about India's hydro-electric potential? What about her coal reserves? Would it not be more realistic to exploit these first? The Government of India has under construction a chain of multi-purpose river-valley projects during the current Five Year Plan. But all the rivers flowing across the face of India and all the coal underground are not enough.

According to authoritative estimates India's coal reserves amount roughly to 100 tons per head of population. This is one-twentieth of the per capita coal reserves of China, roughly one-thirty-fifth that of the U.K. and roughly one-hundred and fiftieth that of the U.S.A. Now if an industrialized India were to consume as much coal per head of population as is done in the U.S.A. today, it would exhaust its coal reserves in about 10 years!

India's major fuel: cattle dung

INDIA'S hydro-electric potential is estimated at between 35 and 40 million kilowatts. That is, when *fully* harnessed—and it is a costly and difficult process—the total hydel (hydro-electric) potential would be barely one-tenth of a kilowatt per person, whereas it is 6 times more in the U.S.A. and 11 times more in Norway even today!

And by the time the water power is fully harnessed, the increase in population will have been formidable enough to cancel the advantage.

The water power resources do not materially alter the long-term problem of India's energy needs. The world reserves of oil are a small fraction of its coal reserves. We therefore come to the inescapable conclusion that all the reserves of hydro-electricity and conventional fuels in India are insufficient to enable it to reach a standard of living comparable with the present standard of the industrially advanced countries.

Actually the most widely used fuel in India today is cattle dung. The ratio of coal, hydel, oil and wood to dung for power use in India is 308 to 1,000, that is, two-thirds of the fuel today is cattle dung: it amounts to about 225 million tons a year. Now if 225 million tons of dung were put into the soil instead of being burnt, it would make a big difference in agriculture.

Again for thermal power stations coal has to be transported over great distances. Coal transport is heavily subsidized, the subsidy varying from 30 to 100 per cent of the cost of the coal. This enormous figure becomes even more significant when it is realized that coal is one-third of the total ton-mileage of goods carried by Indian railways. The relief to the railway-system—one ton of uranium instead of 10,000 tons of coal—would be enormous.

Energy hidden in the sands

BUT is nuclear power an economic proposition in India? Estimates taken from England show that the capital cost per kilowatt of atomic power—in a 250 megawatt station—would be Rs.1,600. Now, in a hydro-station of the same power (250 Megawatts), for instance Koyna or Rihand, the capital cost per Kilowatt is Rs.1.780 and Rs.1.810. Of course, there are no fuel costs in a dam—the water does the job—but nevertheless this large amount of initial capital has to be found.

Has India the necessary nuclear fuel? A systematic survey of uranium in the country began in 1949, and modern techniques such as surveys by helicopters and aeroplanes fitted with scintillo-meters were introduced in 1954. This has already doubled India's known reserves of uranium. Although it is not rich in uranium, India can produce enough for its purposes. Uranium will be converted into plutonium; and when this plutonium is fed into a thorium breeder-reactor, uranium-233 is bred from the thorium and thorium can thus be used as the fuel for India's power plants.

Once there is enough plutonium for basic requirements, natural uranium can be completely eliminated and only thorium used.

India has one of the largest deposits in the world of monazite, the thorium bearing sand. Thorium was previously imported (it was used for gas lamp mantles). Today it is supplied by the Thorium Plant at Trombay and India now exports thorium to countries in Europe and the East. The important thing is that even the Indian known reserves of uranium and thorium are equivalent in energy-value to more than 30 times India's coal reserves. The reserves of uranium and thorium are enough to support a consumption of energy per person equal to that of the most industrially advanced countries for over three centuries.

The Swimming Pool Reactor at Trombay, named "Apsara"—water nymph—which was inaugurated in 1957, last year completed 160,000 KW hours of operation, and the demand on its time has increased so rapidly that it is now running on a round-the-clock schedule.

The special facilities of this reactor are being exploited to the maximum. One feature of the design, which enables the core of the reactor to be worked at three different positions, has proved particularly useful.

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WATER NYMPH *(Continued)*

Reactor with a round-the-clock schedule

The reactor has been used for experiments in physics and as an irradiation facility in biological and chemical investigations, and also in the production of small quantities of radio-isotopes. Many new and interesting results have been obtained in the study of low energy nuclear reactions, such as the angular distribution of secondary radiations from fission and the number of neutrons emitted from fast fission.

The reactor has also been used extensively in the applications of atomic energy to agriculture and biology. Various types of agricultural material such as linseed, cotton, sugar-cane buds, tapioca and wheat have been irradiated in this reactor. These samples have been provided by various research institutions all over India.

Several interesting observations on the effect of radiation on biological cells have been observed, such as the possibility of early ripening of rice, and similar experiments on other types of agricultural material are in progress. Small investigations and medical therapy have been produced. A plant has been set up for the production of high purity radio-isotopes for medical work. Larger quantities of these will available to the public than hitherto supplied.

The reactor is also being used as a source of neutrons for producing the rarer isotopes to study nuclear spectroscopy, and as a source of sodium 24 for the analysis of heavy water. The reactor is also used for studying radiation damage and chemical processes.

Many universities and research institutions are now making use of the research facilities of this reactor, and fellowships have been offered to students in South East Asian countries, Poland and Yugoslavia.

Certain death to insect pests

ANOTHER reactor, the Canada-India Reactor, is being built near the Apsara. The special steel dome which will house it is already completed and the civil engineering work is in progress which will be completed by December 1959. A few months later it will go into operation using natural uranium as fuel.

Work on the first atomic station in India is scheduled to start this year but it is likely that foreign exchange difficulties may hold up the work.

Thorium will replace uranium as the nuclear fuel, but the quantity of thorium India can use after a certain period will depend on what is done now. It will depend on how much plutonium is produced now from uranium in the reactors. The rate of expansion of nuclear power plants is entirely determined by this process of "breeding" thorium.

The peaceful uses of India's work in the field of radio-activity holds out great hope for the future. India's basic problem is food. But the problem is only marginal, the deficit being only about three per cent. Much more than three per cent is lost from rotting and from the scourge of pests. It is possible to control both of these by irradiation. Considerable research has already been done elsewhere in insect control. This work will shortly be taken up at Trombay. It may soon be possible to irradiate grain which goes to granaries so that once the grain is stored no pests will touch it and the grain will not rot because the pests and weevils are killed by radiation.

A storage block of the Canada-India Reactor is being designed for research in the preservation of food. It is even possible to prevent the growth of some species of pests in nature. Male pests are made sterile by irradiation and the sterile males are then released into the field during the breeding season. The female of the species mates only once, and if mating occurs with a sterile male she does not reproduce. This automatically reduces the number of pests.

TWO GREAT EYES cover most of the head of the dragonfly, each eye having from 20,000 to 25,000 tiny eyes joined together. Scientific observations appear to confirm that among insects, those equipped with multi-lensed eyes like the dragonfly (above) perceive colours most easily.

Photos © R.H. Noailles

BIRDS REACT in general to vivid colours and discern yellows, reds, greens and oranges with special clarity. It is the brilliance of colour that attracts a bird, whether it be some conspicuous patch on a plumage, the petals of a flower or the glitter of bright objects. Photo shows a young rock dove.

MEMBERS OF THE SHRIMP FAMILY, whether of the larger species such as prawns (above) or the smaller common salt water shrimp are known to have colour sense. Probably all the fish species which can change their colour to match their surroundings can see those, and perhaps other colours

'Aficionados' won't believe this, but...

BULLS DO NOT SEE RED

by David Gunston

Do animals see colours? It is an interesting question, hard to answer fully and conclusively. We, who see everything coloured, can scarcely imagine a world totally devoid of colour. For this reason we tend at first to assume that all other creatures see the same multi-coloured scene as ourselves. This is not so, of course.

Colour is in itself such an arbitary, intangible thing, and colour sense a faculty so difficult to test or explain, that it has always been difficult for scientists to expound about it with assurance. No object really contains colour, it merely absorbs the white light of daylight, as everything does, reflecting back only one of the components of that light, of the spectrum. Thus a green leaf absorbs all the hues of the spectrum except green, which it reflects, thus appearing itself to be green to our eyes.

Just try to explain to a blind person, for instance, what red is without the use of comparison. It is quite impossible. Quite apart from the widespread prevalence of partial or minor human colour blindness, and the different interpretation put on the same intrinsic colour by different people, it is also as well to remember that our appreciation of colour is still developing and changing. For instance, Homer always called the sea wine-red, and the Ancient Greeks frequently referred to the normal human face as green!

Ultimately, everything depends on the optical receiving apparatus involved. A slight defect or variation there, and the person concerned may be partially colour-blind—perhaps owing to the lack of one of the three light-sensitive "pathways" from retina to brain. Each transmits its own primary colour, red, green or blue (1). Most people we call colour-blind are in fact only partly so, having the green pathway missing, while a much smaller group lack the red pathway, and so are red-blind. These variations are physically very slight, and are confined entirely to what we know as the nervous system; there is thus the strongest evidence that animals, many of which have eyes closely similar to our eyes, lack these small features which give a colour sense entirety.

Monochrome world of the mammals

From all this we can see just how difficult it is to apply our own limited and tentative knowledge of colour vision—always remembering that we, ourselves, may in some slight respect be colour-blind—to other creatures. The subject is one that has provoked a great deal of research, much of it inconclusive.

It is endlessly difficult to be dogmatic about whether an animal can see a colour. No animal can reply articulately to a direct question. Furthermore, in almost all tests made with animals it is difficult to be absolutely sure that the subject of the experiment is not choosing or distinguishing between the colours shown by brightness or whiteness, and not by colour. For that reason, any test that is to be of value must employ colours of identical brightness and proportion of whiteness. Otherwise, the creature, particularly if it is an intelligent one, may distinguish between red and green solely by brightness, just as many colour-blind human beings do.

But within the obvious limitations, we do know something of the subject. Enough, for instance, to say quite definitely that almost all the mammals, with the notable exceptions of the apes and the monkeys, do not see colours at all. They live in a world of blacks and whites and a fair range of greys. What they do often see quite clearly is the difference in the intensity of the blacks, and in the light intensity of the whites and greys, which not infrequently leads people into thinking that animals like dogs must in fact see certain colours.

How many times has a fond owner of a pet dog sworn that his or her animal can always recognise a certain coat or dress when worn by someone the dog may not know, or can tell a particular dish or cushion solely by its colours! It may sound strange to live in a monochrome world, but most mammals are nocturnal, or at least crepuscular, in habit, venturing forth only when the world itself is a shadowy, dark colourless place, lit only perhaps by the pale deceiving light of the moon.

Learning to feed by colours

But we ourselves might not find it so strange. We have never thought ordinary black-and-white movies unnatural, and most newspaper and magazine photographs are still reproduced in monochrome, yet we recognise them as a reflection of life. Even a simple black-and-white line drawing may be uncommonly natural and vivid to our eyes; for all the human passion for colour, we actually feel its absence less than we imagine.

Dogs, cats, rabbits, rats, horses, sheep and even bulls, we are certain, do not know colour in our sense of the term. A great many experiments have been made on the colour vision of bulls in Spain, in connexion with the bull-fighting technique, and although they have all shown that no bull can distinguish red as red, clear and distinct from any other shade, and that bulls generally are not in any way sensitive to red, the age-old art of the toreador and his assistants with their red cloaks is unlikely to be changed The red cloak is part of the tradition of the sport and will doubtless remain, even though those who use it know full well that it is the fluttering, taunting sight that induces the beast to charge, not its colour. A bull determined to charge will do so regardless of what colour is dangled before it.

A good deal of experimenting with other mammals has achieved similar results, particularly with cats, horses, rats and dogs. The tests usually take the form of training the animal to associate food with a particular colour, whilst showing it at the same time another colour unaccompanied by food. When the creature makes the correct choice, more often than not, the colour with no food attached must be gradually changed in intensity to make sure that it is not only relative brightness that influences the subject's decision.

If, at a certain stage in this colour "training", a change in brightness is reached where the animal's reaction breaks down and it expects food equally on either colour, we can say with certainty that it is colour-blind, at least by human standards. On the other hand, if the training holds, and the creature invariably picks the correct colour to obtain food, however much the intensity of the no-food colour is altered, then we can deduce that it is able to distinguish that particular pair of colours one from another. However, this is far from conclusive evidence on colour vision, so the animal must then be re-trained for another quite different pair of colours. Such experiments are inevitably lengthy and difficult, and care has always to be taken external influences like smell, noise, position of food, time of the day, presence of other colours and distracting lights, etc. are avoided.

(1) *The term "primary colours" has become a somewhat elastic description, embracing several different groups of colours distinctive for certain purposes. Red, yellow and blue are primary colours to the artist, but scientifically speaking, the three primaries, or basic colours each requiring its own cone cells in the eye for receiving it, are red, green and blue (or violet). All the 160 odd colour shades known to normal human beings can be made up of varying mixtures of these three primaries—but as light-waves, not paints.*

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BULLS DO NOT SEE RED *(Continued)*

Nevertheless, such tests have clearly shown the inability of mammals generally to recognize colours, and the fact that the apes and the monkeys do have good colour sense. In this connexion between two groups of mammals, it is interesting to note that these colour-conscious species are the only ones to have really bright colours on their own bodies. (It might also be claimed that they have higher intelligence, but there is no correlation between a creature's intelligence and its colour sense—birds, fish, reptiles and insects can in many cases see colours.) One thinks immediately of the bright blues and pinks of the mandrill and other apes, whose significance in courtship rites is well known.

Most other mammals have bodies of duller hue: drab greys, browns, black, fawn in endless combinations, or white itself, largely designed for unobstrusiveness or natural camouflage. Where a brightly-coloured animal is seen, it is usually the result of human inter-breeding, as with dogs, cats and cattle, or else the natural camouflage shade of a creature viewed away from its habitat. The red of the dog fox, the chestnut of the squirrel, the golden-brown of the bear all merge harmoniously into their natural backgrounds. In fact, this presence of bright colours is a rough guide to colour vision in nature, if allowances is made for the possibility of natural camouflage.

Hens are suspicious of blue grain

We see it most clearly shown with birds. They are quite different from mammals, and can see most colours with a vivid intensity. The striking plumage of almost all birds plays a big part in their courtship display, as everyone knows, which is ready proof of their ability to see bright colours. Whether Darwin was right in supposing that the bright coloration of male birds has a survival value by being attractive to the female is a matter for conjecture. What is obvious is the part such plumage plays in a bird's life.

Birds generally see yellows, reds, greens and oranges most clearly. They cannot see blue so well—witness the comparative rarity of really bright blue birds—while very few birds can see violet, as far as we can tell. That shade is even less common on a bird. In addition, where blues or purples do occur in avian plumage, they are nearly always very brilliant, as with jays, kingfishers and macaws, which seems to suggest that these shades can only be distinguished by birds if they are unusually bright.

But the Australian lyre-bird, that feathered oddity of great beauty and mystery, can see both blue and violet, for it goes out of its way to select flowers of these colours with which to adorn its arbour. In the main, however, it is brilliance of colour that attracts a bird, whether it be some conspicuous patch on a mate's or suitor's plumage, the petals of a flower, the shining beam of a lighthouse at night, or the glitter and sparkle of bright objects which jackdaws and magpies steal and hide away.

Experiments on birds have been rather fewer than on mammals, possibly because their ability to see colours is so obviously demonstrated by their own persons. They have also been almost completely confined to those species which can be kept in captivity with ease. One interesting series of experiments with the ordinary domestic hen does however illustrate the peculiar pitfalls present with colour vision tests on birds. Grain was placed before the hens and illuminated by a spectrum of coloured lights. They immediately ate all the red, green and yellow grain, but left that in the blue light, from which it was not unnaturally concluded that these birds, at least, were blue-blind. Only later was it discovered, by further tests, that hens would eat blue grain with a little persuasion. The only reason they were originally shy of it was that they never normally touch any kind of blue-coloured food.

Some fish can see certain colours. Perch, trout, shanny, minnows and others have been proved by tests to be able to recognize a fair range of shades. Perch and other species have been regularly fed on red-stained larvae, and then easily deceived with red wool, while similar tests have been successful with food dyed yellow, orange, green and brown. There is good evidence, too, that prawns and shrimps have a colour sense. Probably

© R. H. Noailles

BUTTERFLIES are classed among those insects which are known to have the most marked sense of colour. (Photo, greatly magnified, shows a butterfly on a flower.) In the case of many pollinating insects, however, the attraction to flowers is created as much by scent as by sight of colours—as in the popularity of willow, ivy and lime flowers to bees.

all those fish species which can change their colour to match their surroundings can see those, and possibly other, colours. Curiously enough, however, no conclusive tests have been made with chameleons, in spite of their well-known colour-changing ability, although this creature probably does see some colours. Certainly turtles have the faculty, and so have many lizards. Lizards known to detest salt have been trained to reject salt-soaked meal-worms on paper of several different colours.

Mosquitoes prefer a black shirt

Insects generally have a colour sense but it varies considerably with species. There have been more tests on the colour vision of bees than any other creatures, which is hardly surprising in view of their value as pollinators and honey-producers. A simple experiment with bees was conducted as follows. Small squares of grey paper of different shades but equal brightness were set like the squares of a draught-board, and one blue square was included in the middle. Each square was fitted with a tiny food dish, but only the blue square's dish had syrup in it. After lengthy trials a bee could be taught to fly straight to the blue square, even when its position was moved about the board. Yet when a red paper of equal brightness replaced the blue, the bee was flummoxed, and could not tell it from the greys.

Bees are not only blind to reds: they live in a world of blues, purples and yellows only, but they (and other insects) can see further into ultraviolet than we can. Many pollinating insects are of course attracted to flowers as much by scent as by sight of colours—witness the popularity of willow, ivy and lime flowers to bees.

As a rule only those insects with highly developed, multi-lensed eyes have good colour vision. Dragonflies probably have the best colour sense in the insect world, with perhaps hoverflies, and some butterflies and moths, as runners-up. House-flies know blue, and dislike it enough to avoid blue-washed windows, or blue walls and curtains, while mosquitoes, which are known to distinguish yellow, white and black, appear to prefer the last-named colour. In a special test made in an infested region in Oregon, seven men wore shirts of different colours. Within half a minute the black shirt had attracted most insects, 1,499 to only 520 on the next infested shirt, a white one!

Letters to the Editor

VINES FOR COLD CLIMATES

Sir,

In your magazine I found a signpost showing me how an ordinary person can help to spread fundamental knowledge and also become an intermediary for the exchange of information on successful applications in science. I got my idea from a story you published about someone who excavated some animal fossils and decided to share these precious relics among museums in several countries.

Since I retired my hobby has been horticulture, and on my small plot I grow fruit trees—mostly of the dwarf variety—and also grape-vines. Here, in the Don region, vines need winter protection and this means covering them with earth. But burying them in the Autumn and uncovering them in the Spring is hard work, and the fact that the buds tend to rot underground affects the quality of the grapes.

The Vine-Growing Institute of Novotcherkassk has therefore successfully produced several dozen different kinds of vines which resist temperatures as low as between minus 30 and minus 36 degrees centigrade and it has made them available to Soviet agriculturalists. I have three of these vines and have already had grapes from them.

As soon as I was sure that my vines were capable of producing good quality grapes I offered to send some to China. Professor Chen-Tsun of the Peking Agricultural Academy accepted my offer and in return has sent me seeds of plants which are rare here. These include the prunus tormentosa (Chinese cherry) the Chinese lemon tree and also the wild vines of the Amur region which are especially resistant to frost.

Now I would like to share my modest stocks with some amateur horticulturists in Western countries and thus, in some small way, perhaps contribute to the maintenance of peace in the world. With the frost-resisting vines I think the growing of vines should begin in Finland and other Nordic countries. Perhaps through your magazine I could make contact with these countries.

Ibrahim S. Aitov
Simferopolskaya ul. 10,
Rostov-on-Don, U.S.S.R.

MORE ABOUT YOUNG PEOPLE

Sir,

Each month I am delighted to find such an interesting selection of articles in THE UNESCO COURIER... I do not agree with those who say that the level of your articles is too high—or too low. It is impossible to please everyone. So continue to choose the best you can from current events and from the material provided by your contributors. I would like, however, to join the Australian reader who asked for articles on youth problems. But please also tell us about the men and women who are trying to solve these problems, about the remarkable advances in the methods used and about the institutions which are successfully overcoming the sad problems of maladjusted children and juvenile delinquency. People are unaware of much of this or are insufficiently informed. They would certainly be interested by it.

R. Trial
Aubais, France

AFRICAN MUSICAL ANTHOLOGY

Sir,

In your February number you announced the issue, under the auspices of the International Music Council, of three records entitled "An Anthology of African Life." Can these records be purchased? If so, where can they be obtained and what do they cost?

M. Périer
Lausanne, Switzerland

Editor's note: "An Anthology of African Life" can be ordered from Ducretet-Thomson, 3 bis, avenue de Friedland, Paris, and costs 6,570 fr. frs.

YOUTH & NATURE PROTECTION

Sir,

In answer to your correspondent M. Teulon, Aude, France, who enquires whether any organization can help in the education of young people about the protection of Nature, I would offer information on the activities of the World Federation for the Protection of Animals which has been admitted to Consultative Status by UNESCO.

This Federation has, as members, over 150 animal protection societies in more than 40 countries and has, therefore, unique facilities available in many languages which are at the service of any individual, organization or government.

The aim of this Federation is to further by educational, scientific and cultural methods the humanitarian outlook of Man towards the lower creatures. Therefore the office of this Federation acts also as a clearing house in this field for information on literature, exhibits and films which are available in the different countries and languages. If your correspondent will be good enough to communicate with the Federation detailing the needs of his centre the Secretariat will endeavour to supply such information or material as is available.

Cecil Schwartz
Secretary General
46 Grosvenor Road
Luton, England

ONE WORLD LANGUAGE

Sir,

In your April issue an Israeli suggests that in a "truly international" university courses should be given in "the main languages, English, French, Spanish and Russian." One wonders what Germans will think of this set of languages—or a Chinese in, say, the year 2000; or a visitor from Mars. No, a United Nations University should use one world language which is fair to all, not the language of any particular nation. The suitability of Esperanto has been proved.

To my mind, rather than a multilingual university there should be an intensive drive to teach Esperanto in the top classes of primary schools as soon as teachers can be trained, and to use Esperanto in higher education as the medium of instruction for teaching world history and other universal subjects.

C.M. Cather
Torquay, England

GANDHI'S LIGHTER SIDE

Sir,

I am writing a book on Gandhi's wit and humour and instances of Gandhi in lighter vein. I invite from your readers instances of Gandhi's humour with them or with any others they know of, so that these facts could be included in my book.

S. Durai Raja Singam
P.O. Box 16, Kuantan
Malaya

FOR OR AGAINST ABSTRACT ART

Sir,

I read with great enjoyment your special issue devoted to UNESCO's new headquarters (November, 1958). As usual, it was produced with abundant good taste and the subject was given a most convincing presentation.

I am studying technology at university, but I am also intensely interested in painting. I was brought up to appreciate the works of painters like Nesterov, Repine and Vrubel, but this does not mean that I think any the less of paintings by Picasso or Matisse, and in no way do I rate modern Western painting as a falsification of true art.

I read the article by R.J. Laurenza, "The Language of Abstract Art", with the closest interest. It offered some interesting ideas on the important role which the development of photography has played in the evolution of abstract art, on the link between abstract art and the successive strata of history, and also on the impact which science has had on painting styles. Yet nothing that was said offered proof of the main thing: the aesthetic value of abstract art.

I should like one of your future issues to be devoted to the subject of modern art, including conclusive arguments "for" and "against" abstract art. It would also be useful to publish reproductions of works by modern painters—the realists, including Soviet artists. These reproductions (Soviet) could even by judged and commented on by Western critics; the results would be interesting.

Rurik Povileiko
Baku, U.S.S.R.

From the Unesco Newsroom...

'PRE-FAB' HOMES FOR POLAR EXPLORERS: A pre-fabricated two-storey house for polar explorers, which weighs about twenty times less than a conventional house of its size, has been designed by a group of architects in Leningrad. The completed structure consists of one or two-room flats with central heating, water mains and showers, drying cupboards and electric cooking stoves. It can be packed for transportation by tractor-drawn sleighs or helicopter and can be assembled at a base camp by about a dozen men.

■ **AFRICA'S NEW TV NETWORK:** *A television network is to go into operation in Western Nigeria later this year. Two transmitting stations with link equipment are to be set up near Ibadan and Ikeja covering the largest concentrations of population in the country. These stations will devote about half their transmission time to educational programmes. Western Nigeria has pioneered in the field of education—it was the first African country to introduce universal free primary education.*

ELECTRICITY FROM THE ATOM: Recently the atomic reactor at Marcoule in southern France started to supply electricity which is now being used for industrial or domestic purposes. France thus became the fourth country in the world to use electricity obtained from nuclear sources, the others being the United Kingdom, the United States and the U.S.S.R.

■ **OUR UNKNOWN OCEANS:** *Today when space research is much in the news there is still another vast field of research much nearer to home which has been barely touched upon: oceanography. Though the oceans cover two-thirds of the earth's surface, scientists admit that they know less about them and the life hidden in their depths than about the face of the moon. Now efforts are being made to increase exploration of the seas.* UNESCO *has already started a project in this field and recently a special committee appointed by the U.S. Academy of Sciences discussed an ambitious ten-year programme for unlocking the ocean's treasures. Recommendations of this committee include grants to universities for the creation of departments of oceanography, fellowships for research students, the equipment of laboratory ships etc. Other proposed projects include mining of the ocean floor, some parts of which are known to be rich in deposits of cobalt, nickel and manganese, and other activities which would call for a vast network of signal buoys, research ships, bathyscaphs and ice-breaking submarines.*

WIND-POWER FOR THE FARM: To supply electricity to isolated farms and rural homes a wind-driven generator can be an economic proposition providing that all the energy becoming available at random times is put to good use. In Great Britain the Electrical Research Association has recently devised and tested an automatic load-distributor which passes the power output to various loads according to priorities which can be fixed in advance. Last December, for example, an 8 K.W. wind-power plant gave an output of 1,080 KWH for a monthly average wind-speed of 12 to 13 m.p.h. The diesel-electric set held in reserve was only needed to provide 17 KWH in the month.

■ **ORGANIZATION UNDERWATER:** *A new international organization with a rather unusual title, "International Underwater Confederation",* (Confédération Mondiale des Activités Sub-Aquatiques) *recently came into being. It was founded at a meeting in Monaco attended by delegates of national federations of skin-divers and undersea explorers from some* 15 *countries. The confederation has set up two committees: one devoted to underwater sports and the other to technical problems involving underwater photography, archaeology, biology and speleology.*

INDIA'S YOUNG SCIENTISTS: Over 300 science clubs are now operating in secondary schools and in agricultural extension services in India. The Science Club movement was started by the All-India Council for Secondary Education during the 1957-58 school year. Besides organizing lectures, discussions and practical scientific work, the clubs help to maintain weather records, set up science libraries and organize scientific exhibitions.

■ **NEVER TOO EARLY...:** *Some* 400 *teachers in schools in* 40 *countries are making steady progress in showing that building international understanding is something that should start in the classroom. How they do so through the Associated Schools Project sponsored by* UNESCO *was described recently by T. Ivor Davies, head of Associated Schools' work in Britain, to educators at the Conference of Internationally-Minded Schools, held at* UNESCO *House, Paris. He pointed out that teaching about other peoples and their contribution to the world can be included in nearly every course—in geography, science and mathematics... and even a minimum effort can help to eradicate prejudices among schoolchildren.*

TV NEWS OF NEIGHBOURS: Televiewers in several European countries have recently been able to follow on their screens events in each other's countries on the same day they have taken place. This has been made possible by an experiment in Eurovision—an international television link-up—planned by the European Broadcasting Union for the exchange of news programmes. Programmes were filmed in various countries and transmitted over the Eurovision network during off-peak hours. They were recorded on kinescope by the receiving stations and, after editing, were included in newscasts on national networks.

■ **JAPAN'S PEACEFUL ATOMS:** *By an agreement which was signed in Vienna recently Japan became the first country to buy nuclear fuel for research purposes from the International Atomic Energy Agency, and the Agency assumed its major role as a supplier of such material for peaceful activities. Japan is buying three tons of natural uranium for use in a low power research reactor. The uranium in question will be furnished to the Agency free of charge by the Canadian Government as part of its contribution to the IAEA programme.*

2,000 OF WORLD'S ELECTRONIC CALCULATION SPECIALISTS TO MEET AT UNESCO CONFERENCE

A UNESCO-sponsored International Conference on Information Processing will bring some 2,000 of the world's leading authorities on electronic calculators to Paris this month. Opening at the Sorbonne on June 15, the conference will be attended by scientists from thirty-three countries of Europe, Asia, the Middle East, the Americas, Africa and the Pacific region. Among the largest national groups due to take part are France (300), Germany (160), Italy (60), Japan (20), the United Kingdom (100), the United States (300), and the U.S.S.R. (60). At sessions in UNESCO's Headquarters, from June 16 to 20, specialists will hear and discuss reports on such themes as : methods of digital computing, logical design of digital computors, common symbolic language for digital computors, automatic translation of languages, pattern recognition and machine learning. In all, fifty-eight scientific papers will be discussed. To familiarize the public with the principles and applications of electronic calculation, special lectures will be given each evening, while plenary sessions and symposia will also be open to the public. The first international exhibition of information processing equipment—"Auto-Math 59"—is being held in Paris at the same time, and will thus serve both as a background to and illustration of the main conference themes.

Imp. GEORGES LANG, PARIS. IMPRIMÉ EN FRANCE.

WINDOW ON THE WORLD

Once a month THE UNESCO COURIER presents to its readers a panorama of the modern world. Without being either too learned or too "popular" in its approach, its well-illustrated articles give a vivid picture of the endless diversity of peoples and countries. There is no facet of the present-day world on which it does not touch—the sciences man has developed, the cultures he has created, the knowledge he has amassed.

THE UNESCO COURIER, now in its twelfth year, does more than merely satisfy the desire for information about contemporary problems; it throws light on every aspect of human endeavour, strengthens the links between the peoples in every corner of the globe, fosters international understanding and advances the cause of peace.

You can help by telling your friends, colleagues and business associates or your local librarian about THE UNESCO COURIER. It also makes an ideal birthday gift. As a gift for your friends abroad, you can subscribe to the French, Russian or Spanish editions.

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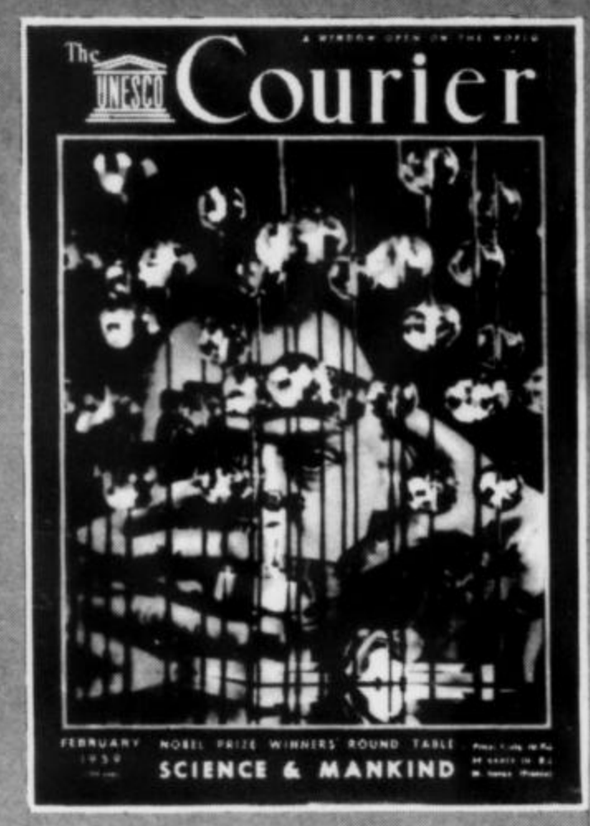

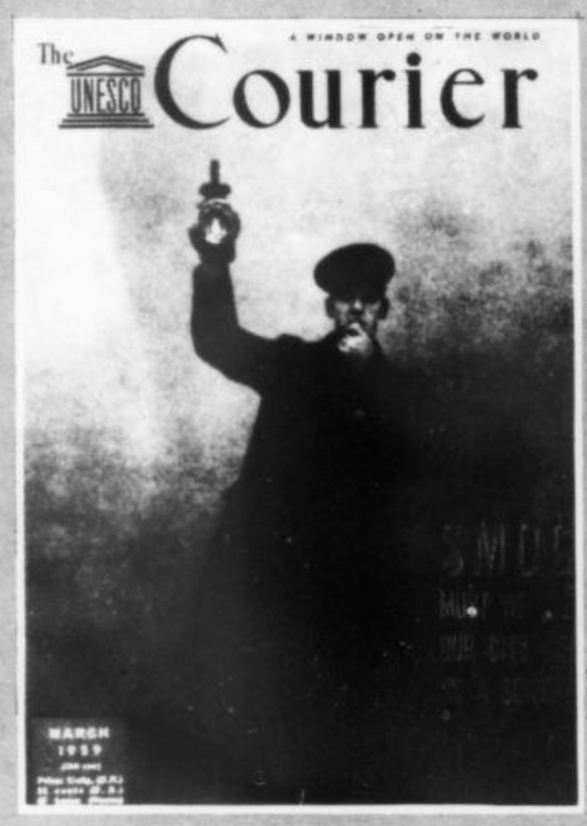

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AIR POLICE WATCH OVER CITY TRAFIC

To keep the stream of weekend and holiday traffic moving smoothly, New York City's police department supplements its ground force with a fleet of helicopters. This double-page photo shows a helicopter hovering over a main road system in Queens, one of New York's five boroughs. Air police constantly send radio traffic reports to headquarters as thousands of automobiles move out of and into the city over scores of main thoroughfares, bridges, tunnels and ferries. Reports are transmitted to motorists via radio. Air police observe road congestion in the making and direct re-routing of traffic by radio. Spotting break-downs, they call for a repair truck. In emergencies they air-lift critically ill or injured persons over congested highways to hospital.